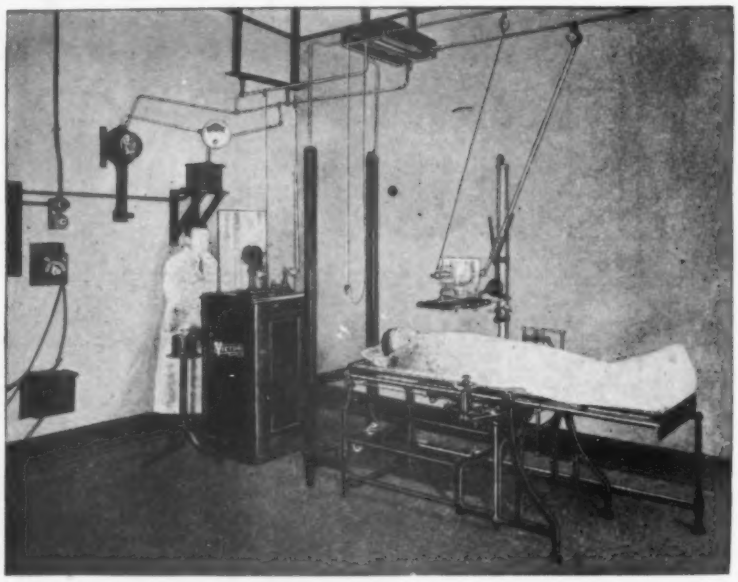
Medical Library

THE JOURNAL OF RADIOLOGY

VOL. IV APRIL 1923 No. 4

PUBLISHED MONTHLY BY
THE RADIOLOGICAL SOCIETY
OF NORTH AMERICA
AT OMAHA, NEBRASKA



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The JOURNAL OF RADIOLOGY
Omaha, Nebraska
VOL. IV APRIL 1923 No. 4

A New Technique for the Positive Identification of the Sphenoid Sinus and the Ethmoid Cells*

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I REGRET that time will not permit me to review the excellent work done by others in this important field, but constrains me to limit my remarks to a brief description of the experiments which I have made on dried skulls and in one instance on the head of a living subject, and to show you the results obtained on these and on patients suffering with diseases of the accessory sinuses.

I was induced to make these experiments because of not being satisfied with the results obtained with the various techniques recommended. I had found that the diagnosis of disease of the sphenoid sinus could not be made with any degree of certainty, and in fact I could not be certain always of the positive identification of this sinus and of the ethmoid cells by known methods. Added to these difficulties were the ones of not being able always to show the same landmarks on skiagraphs of different heads and indeed not always on the same head when made at different times.

These last difficulties were unquestionably the result of some change, no matter how slight, in the position of the head and of the tube when the several exposures were being made. Conversations and correspondence with confreres brought out the fact that they were experiencing the same difficulties.

I was very fortunate while carrying out these experiments, in obtaining the cooperation of Dr. L. S. Gaudet, Lecturer on the Anatomy of the Ear, Nose and Throat in the Post-Graduate School of Medicine of Tulane University, who prepared the dried skulls, and filled the sphenoid sinus and the ethmoid cells with the opaque substances; and of Dr. G. J. Taquino, Assistant Professor of the Ear, Nose, and Throat in the same school, who furnished most of the clinical material for this study and who filled the sphenoid sinus of the living subjects with opaque material.

Too many thanks cannot be rendered to both these gentlemen for their unfailing interest and their invaluable assistance, without which this accurate and exhaustive study of the sphenoid sinus and the ethmoid cells could not have been made.

I wish also to render thanks to my technician, Mr. Guy R. Buisson, who developed the films and made the reductions and lantern slides, for his painstaking and efficient assistance.

First Experiment

A dried skull was sawed through the sagittal plane, just to one side of the nasal septum thus exposing to full view the sphenoid sinus and the ethmoid cells. On the right side, the sphenoid sinus was filled with plaster of Paris and the posterior ethmoid cells were filled with Mellotte's metal, and on the left side, the anterior ethmoid cells were filled with amalgam, after which the two halves of the skull were glued together.

Numerous skiagraphs of the skull were made in the postanterior position beginning first with the accepted 25°

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 8, 1922.

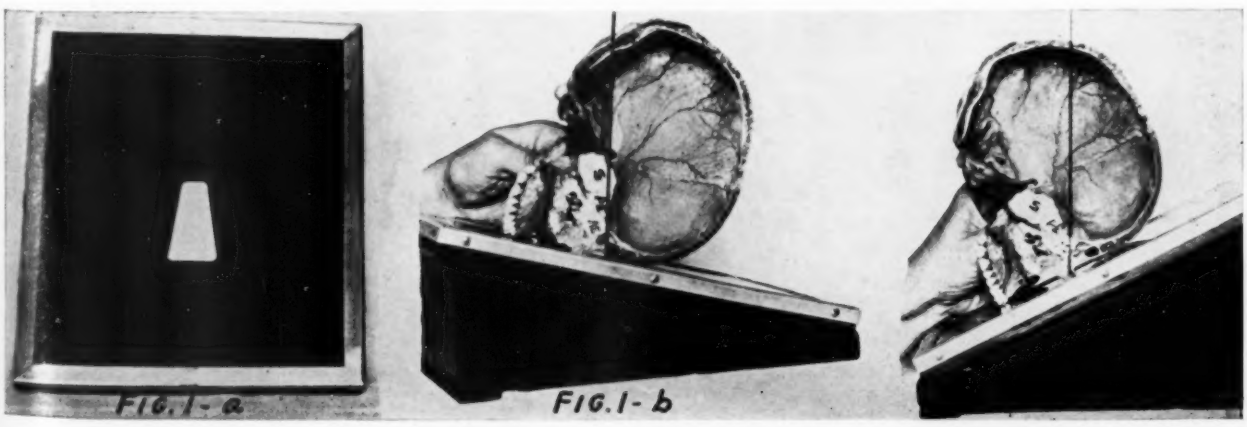

Fig. 1—(A) Author's head rest. (B) Sectional view of skull D resting on angle block in the position for making 107 degree angle skiograph. (C) Sectional view of the same skull resting on angle block in the position for making the 23 degree angle skiograph. The filled sphenoid sinus and the posterior and anterior ethmoid cells can be plainly made out. The path of the central rays, indicated by the vertical black line, is through the anterior ethmoid cells in C and through the upper portion of the sphenoid sinus in B, and the difference in the relative positions of the sphenoid sinus and the posterior and anterior ethmoid cells is seen in the 23 degree and 107 degree angle views is explained at once.

and 13° angles and then varying the position of the head and tube until the desired results were obtained.

To facilitate our work we had made out of wood and beaver board two light weight angle blocks of 25° and 13° respectively.

But our success was due mainly to the use during these experiments of a head rest which I had previously designed and which had proved of inestimable value when making postanterior views for the examination of the accessory sinuses.

This head rest (Fig. 1A) consists of a sheet of bakelite, with a triangular hole cut for the nose, attached to a wooden frame ½ inch high and about ¾ inch wide, the whole surrounded by a strip of wood ¼ inch thick and ¼ inch deep. By these means the bakelite sheet upon which the head will rest can be securely held over a film holder or cassette and at the same time kept a distance of ½ inch away. When the nose is placed in the hole cut out in the bakelite sheet—the size and position of this hole having been carefully determined—the head is automatically centered on the same part of the film, the soft tissues of the nose can be compressed without pain or discomfort and what is much more important, the head now rests *on the superior maxilla and the glabella*. Two constant fixed points, varying little in heads of different sizes and shapes, now afford good firm support to the head, doing away entirely with the tendency to pivot either in the direction of its longitudinal or transverse diameter, a tendency always present when the nose is one of the two points on which the head rests.

This was definitely and abundantly proved during our experiments with the dried skulls. By making use of the head rest described above, we were able to reproduce skiagraphs identical in every particular as often as desired.

Landmarks

As a result of these experiments, I present for your consideration Figure 2A, a postanterior view of a skull resting on a 23° angle block. The shadows cast by the filled sphenoid sinus and by the ethmoid cells are clearly brought out and can be readily seen. You will observe (1) that the sphenoid shadow is bounded above by the line X. This line X is formed by the anterior border of the optic groove, and the upper roots of the lesser wings of sphenoid. The shadows produced by the lesser wings of the sphenoid can be seen continuing outwards through the orbits; (2) that as is nearly always the case one sphenoid, the right one in this skull, is larger than the other; (3) the anterior ethmoid cells are situated just below the frontal sinuses.

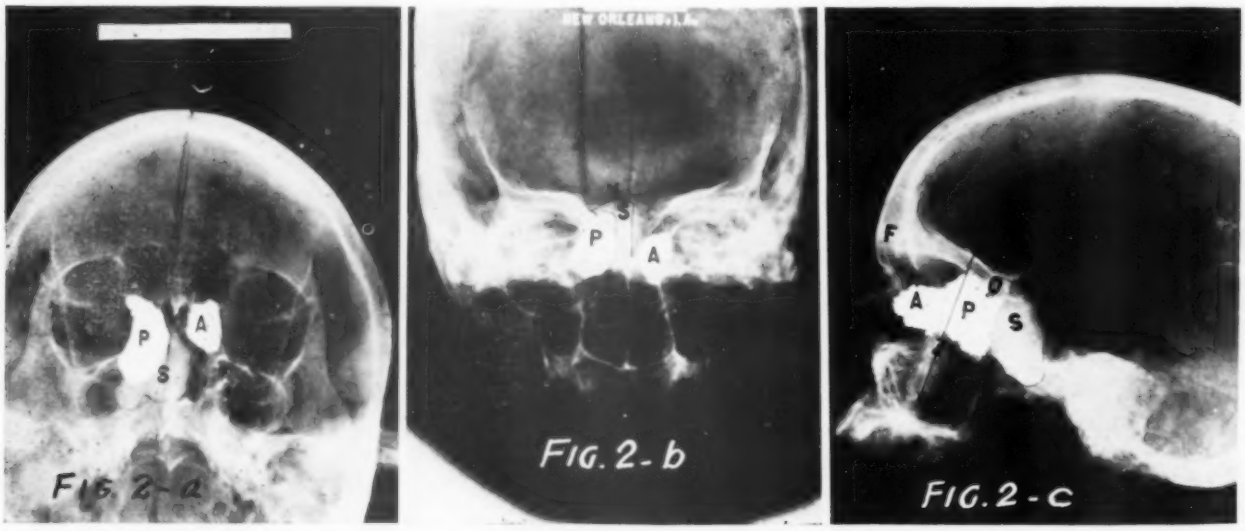

Fig. 2—Skull A, with the sphenoid sinus and the posterior ethmoid cells on the right side and the anterior ethmoid cells on the left side filled with opaque materials. (A) Posterior anterior view 23 degree angle: X upper boundary of the sphenoid sinus. (B) Posterior anterior view 107 degree angle: Y, upper boundary of sphenoid sinus. (C) Lateral view: O, anterior boundary of sphenoid sinus. Z, boundary line between the anterior and the posterior ethmoid cells. S, sphenoid sinus. P, posterior ethmoid cells. A, anterior ethmoid cells. M, maxillary sinus. F, frontal sinus.

Fig. 3—Skull B: (A) Posterior anterior view 23 degree angle: X upper boundary of sphenoid sinus. (B) Posterior anterior view 107 degree angle; Y, upper boundary of sphenoid sinus. (C) Lateral view; O, anterior boundary of sphenoid sinus; Z, boundary line between the anterior and the posterior ethmoid cells. S, sphenoid sinus. P, posterior ethmoid cells. A, anterior ethmoid cells. M, maxillary sinus. F, frontal sinus.

Figure 2B is a postanterior view of a skull resting on a 107° angle block. It shows the sphenoid sinus and the groups of ethmoid cells appropriately marked, clearly defined, and limited by the different densities of the opaque substances with which they are filled. You will observe that the sphenoid shadow is bounded above by the curved line Y. *This line which I consider the most valuable landmark is formed by that portion of the bony wall of the sphenoid called the optical groove.* It curves downward on each side towards the optical foramen and the anterior clinoid processes.

Making use of my head rest, in order to have the head rest firmly on the superior maxilla and the glabella, and with the 17° angle block placed so as to give the head an inclination of 107° no difficulty whatever was experienced in making post-anterior skiagraphs showing the very important landmark described above.

You will observe further that the shadow of the filled ethmoid cells is bounded above by a line formed by the lesser wing of the sphenoid and which extends outwards and usually upwards; and its inner boundary is indicated by the vertical line formed by the superior turbinate bones. The posterior cells lie above and the anterior cells below the shadow of the middle turbinate bones.

Figure 2C, the lateral view of the same skull, shows the shadow of the filled sphenoid bounded anteriorly by the curved line formed by the shadow of the greater wing of the sphenoid. This line which serves as the anterior boundary of the middle cerebral fossa also serves as a fairly constant and accurate boundary line between the sphenoid shadow and that of the posterior ethmoid cells. A line Z arbitrarily drawn along the posterior border of the orbital process of the malar serves as a fairly accurate boundary between the posterior and the anterior groups of ethmoid cells. I doubt whether a more practical boundary line can be found because although the shadow produced by the anterior ethmoid cells is usually larger than that produced by the posterior cells on account of the larger number of the former, it happens not infrequently that the posterior cells are of such large size that they produce a shadow as large and even at times, larger than that produced by the anterior cells (Fig. 2).

Three other skulls were obtained—Skulls B, C, D—and it can be seen from their photograph (Fig. 9) that

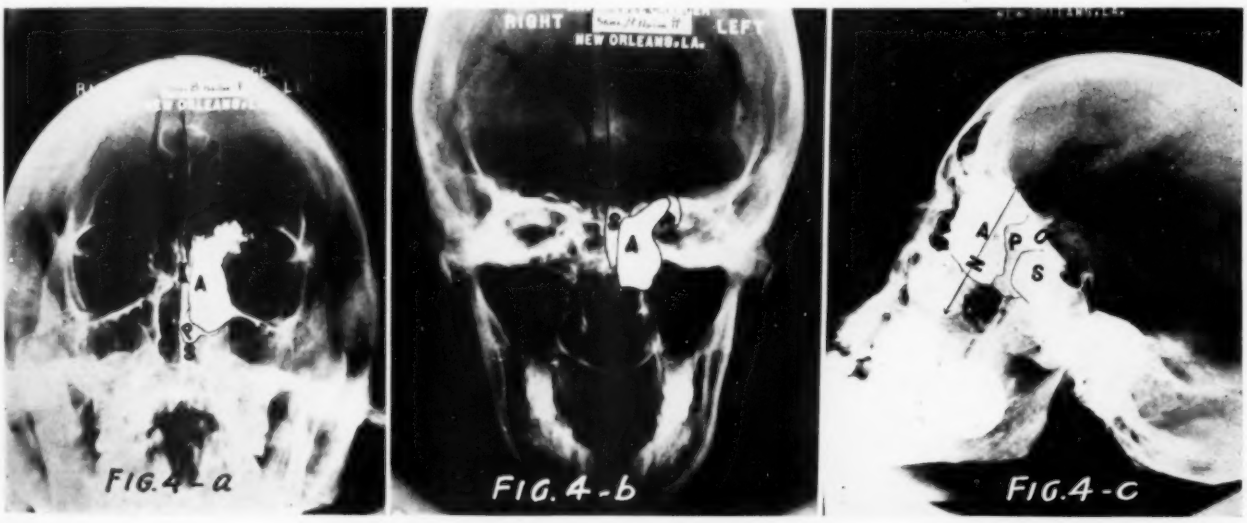

Fig. 4—Skull B, with the sphenoid sinus and the ethmoid cells filled with opaque materials on the left side. (A) Postanterior view of 23 degree angle; X, upper boundary of sphenoid sinus. (B) Posterior anterior view 107 degree angle; Y, upper boundary of sphenoid sinus. (C) Lateral view; O, anterior boundary of sphenoid sinus; Z, boundary line between the anterior and the posterior ethmoid cells. S, sphenoid sinus. P, posterior ethmoid cells. A, anterior ethmoid cells. M, maxillary sinus. F, frontal sinus.

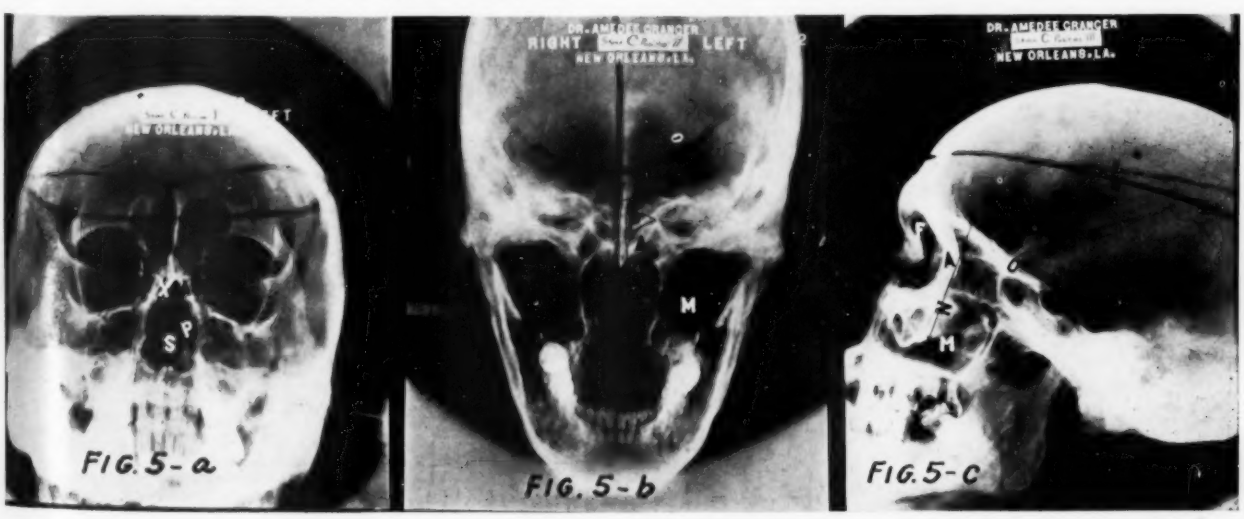

Fig. 5—Skull C: (A) Posterior anterior view 23 degree angle; X, upper boundary of sphenoid sinus. (B) Posterior anterior view 107 degree angle; Y, upper boundary of sphenoid sinus. (C) Lateral view; O, anterior boundary of sphenoid sinus; Z, boundary line between the anterior and posterior ethmoid cells. S sphenoid cells. P, posterior ethmoid cells. A, anterior ethmoid cells. M, maxillary sinus. F, frontal sinus.

they varied greatly in size and shape. They were each sawed in the sagittal plane the same as Skull A, but this time it was decided to fill the sphenoid sinus and the two groups of ethmoid cells on the same side provided that three substances opaque to the x-rays could be obtained which would produce shadows of different densities so that these could be differentiated on the skiagraphs.

After considerable experimentation, it was found that this could be done by filling the sphenoid sinus with plaster of Paris, the posterior ethmoid cells with a thick paste of sapolin and the anterior ethmoid cells with zinc oxide powder worked into a paste with oil of cloves. A study of Figures 3 and 4, 5 and 6, 7 and 8, sets of skiagraphs made of skulls B, C, and D, respectively, before and after the sphenoid sinus and the ethmoid cells were filled with the substances mentioned above, demonstrates conclusively: (1) that by employing the technique recommended, it was possible to duplicate the skiagraphs with great precision; (2) that the skiagraphs of these three skulls do not show as great differences in their appearance as their photographs do (Fig. 9); and (3) that the important landmarks previously described can be readily and positively identified.

A careful study of Figure 11, a set of skiagraphs of the head of a normal individual made by employing this technique and showing clearly all the landmarks described, should prove highly instructive.

Figure 10, a set of skiagraphs of the head of a patient on whom a radical operation for frontal, ethmoid and sphenoid sinusitis was performed several months ago, and in whose sphenoid sinus a thick paste of bismuth was packed through an unusually large opening resulting from the radical operation, is most interesting because it proves in the living head the accuracy of the landmarks obtainable with the method of examination recommended.

It will be observed that the shadow produced by the bismuth paste (Fig. 10) lies below line X (the upper boundary of the sphenoid sinus in position A); below the curved line Y

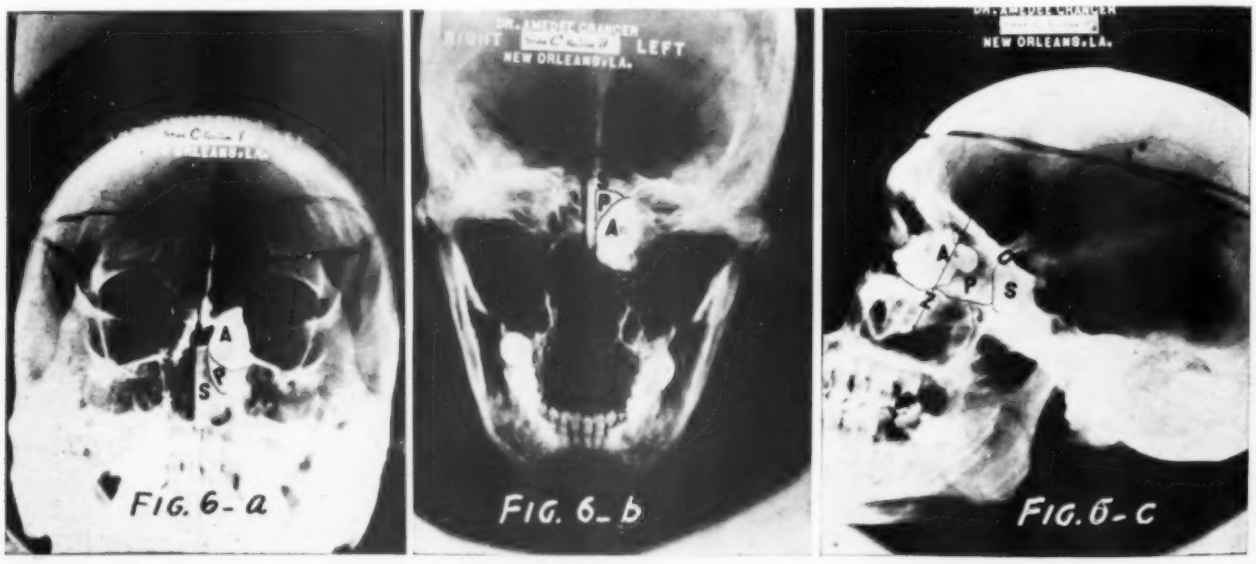

Fig. 6—Skull C, with the sphenoid sinus and the ethmoid cells filled with opaque materials on the left side. (A) Anterior view 23 degree angle; X, upper boundary of sphenoid sinus. (B) Posterior anterior view 107 degree angle; Y, upper boundary of sphenoid sinus. (C) Lateral view; O, anterior boundary of sphenoid sinus; Z, boundary line between the anterior and the posterior ethmoid cells. S, sphenoid sinus. P, posterior ethmoid cells. A, anterior ethmoid cells. M, maxillary sinus. F, frontal sinus.

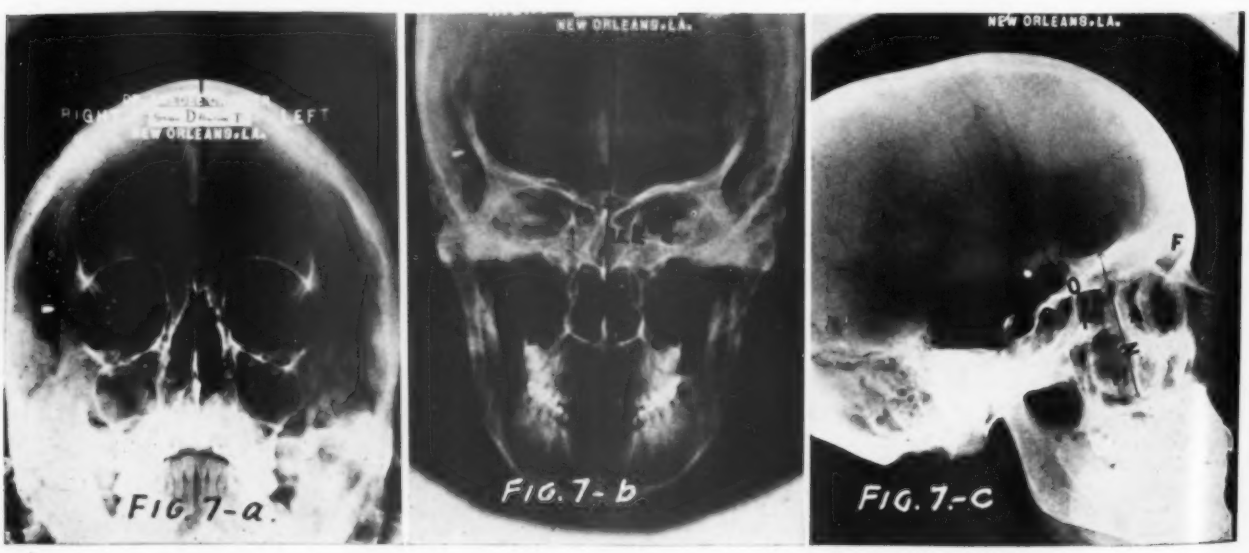

Fig. 7—Skull D: (A) Posterior anterior view 23 degree angle: X, upper boundary of sphenoid sinus. (B) Posterior anterior view 107 degree angle: Y, upper boundary of sphenoid sinus. (C) Lateral view: O, anteriar boundary of sphenoid sinus; Z, boundary line between the anterior and the posterior ethmoid cells. S, sphenoid sinus. P, posterior ethmoid cells. A, anterior ethmoid cells. M, maxillary sinus. F, frontal sinus.

(the upper boundary of the sphenoid sinus in position B); and behind the curved line O (the anterior boundary of the sphenoid sinus in position C).

It will be observed further that the opaque shadow does not reach the lines X and Y because the hyperplastic changes in the mucous membrane lining the sphenoid sinus prevented the bismuth paste from getting closer to its bony wall. These hyperplastic changes are clearly shown in the very marked increased density to be seen below the sphenoid curve Y.

INTERPRETATION AND DIAGNOSIS

When studying Figures 4, 6, 8, of the filled skulls, it must be noted that the shadows of the filled sinuses occupy the following order from above downwards, viz: Anterior Ethmoid, Posterior Ethmoid, Sphenoid in Position A (23° angle) and Sphenoid, Posterior Ethmoid, Anterior Ethmoid in Position B (107° angle) because this has an important bearing on the interpretation of these skiagraphs.

A glance at B and C of Figure 1, a cross section view of a filled skull in proper position on the head rest, and on the 107° angle and the 23° angle blocks respectively, with the path of the central ray indicated by a vertical black line when the skiagraphs in position II and I respectively were made, will give the explanation of the observation noted above.

It was noted further that whereas the curved line Y is plainly seen in its entirety in the skiagraphs of the unfilled skulls, it was seen faintly or not at all in the skiagraphs of the filled skulls on the side which is filled, where its shadow blends with that of the opaque material filling the sinus, but remains distinctly visible on the unfilled side. This observation is of the greatest diagnostic value as will be shown later. (See Figs. 7B and 8B.)

Although convinced that position B gives the most important information concerning all the sinuses except the frontals, I do not consider that a thorough examination of the accessory sinuses has been made unless the head has been skiagraphed in positions A and C also. Position A besides furnishing very valuable data with regard to the frontals and the maxillary becomes a valuable check on the findings obtained from position B. While position C checks up and confirms the findings in the other two positions of the head and in cases where the disease of the sphenoid is looked for gives additional and valuable information regarding the size and density of that sinus, and the size and condition of the sella and of the anterior clinoid processes.

For example, cloudiness or opacity immediately below the line Y with this line indistinct, absent, or thickened in position B; below line X and extending to or beyond the median line in position A; and behind curved line O in position C, with or without alterations of the sella and the anterior clinoid processes, means pathology or abnormality of the sphenoid sinus.

Cloudiness or opacity of the lower portion of the ethmoid region in position B, in the upper portion of the same region in position A, and in front of line Z in position C means pathology

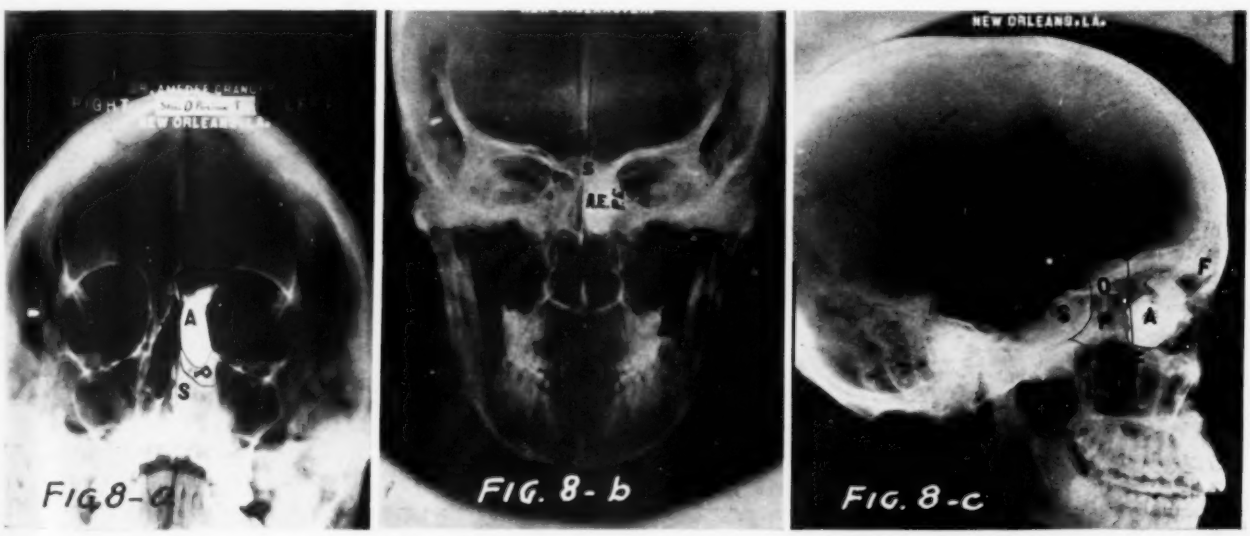

Fig. 8—Skull D, with the sphenoid sinus and the ethmoid cells filled with opaque material on the left side. (A) Posterior anterior view 23 degree angle: X, upper boundary of sphenoid sinus. (B) Posterior anterior view 107 degree angle: Y, upper boundary of sphenoid sinus. (C) Lateral view: O, anterior boundary of sphenoid sinus; Z, boundary line between the anterior and the posterior ethmoid cells. S, sphenoid sinus; P, posterior ethmoid cells. A, anterior ethmoid cells. M, maxillary sinus. F, frontal sinus.

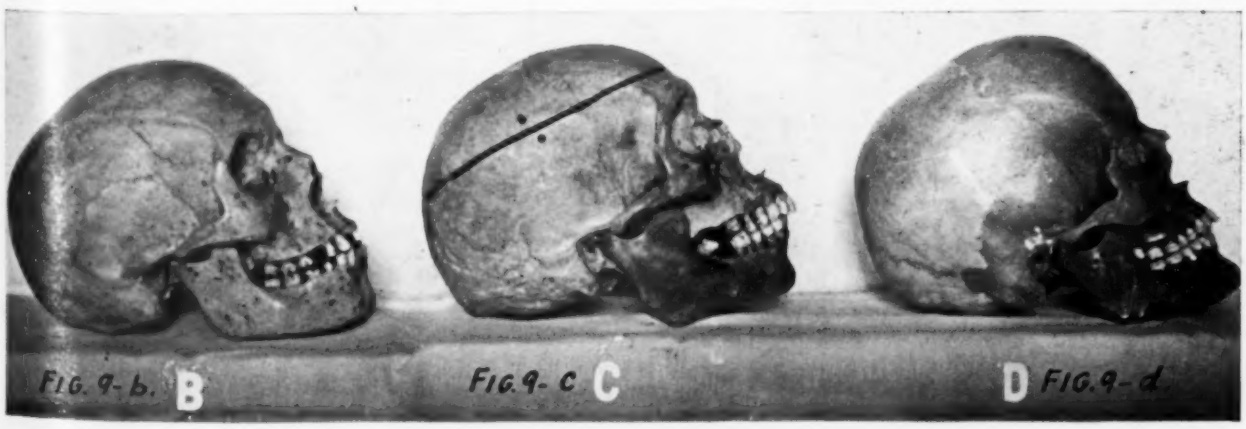

Fig. 9—Skulls B, C, D.

or abnormality of the anterior ethmoid cells.

Although the time is too short and the clinical cases proved by operation too few to enable me at this writing to lay down any hard and fast rules of interpretation, nevertheless the following important observations have been recorded and have proved of inestimable value since with their knowledge I have been able to diagnose unilateral sphenoid disease and in several instances, when disease of the sphenoid was suspected, to state correctly that such was not the case.

Indistinctness or absence of the curved line Y (position B) either on one side or in its entire length, with increased density or opacity of the sphenoid region was noted when one or both sinuses were filled with polypoid tissue (Fig. 12).

Increased thickness or density of the curved sphenoid line on one side or throughout its entire length, produced unquestionably by osteoplastic changes in the sub-periosteal bone of the sphenoid, associated with cloudy or opaque sphenoid sinus and ethmoid cells, and with similar hyperplastic changes in the ethmoids seen in the increased visibility of the walls of the ethmoid and their cell divisions, was observed in several cases of chronic suppuration of the sphenoid and post-ethmoids (Fig. 13).

In a patient suffering with optic neuritis on the right side, the right half of the curved sphenoid line was found to be thickened (Fig. 14).

I have become convinced that it is possible by a careful study of a set of skiagraphs made in the three positions recommended, noting particularly changes in the curved sphenoid line Y, in the density of the shadow of the sphenoid sinus and the ethmoid cells, changes in their walls and in the case of the ethmoid cells of the cell divisions, to make earlier and more positive diagnoses of diseases of the sphenoids and the ethmoids than was possible heretofore.

Furthermore, I believe that the results already obtained from our experiments and observations justify us in making the following statements which we hope to see corroborated at an early date. In cases of acute sphenoid sinusitis, when the sinus is filled with pus, but when no hyperplastic changes have taken place, the sphenoid region should be denser and the curved sphenoid line indistinct or absent on the affected side, if only one sinus is diseased, and throughout its whole length if both sinuses are diseased.

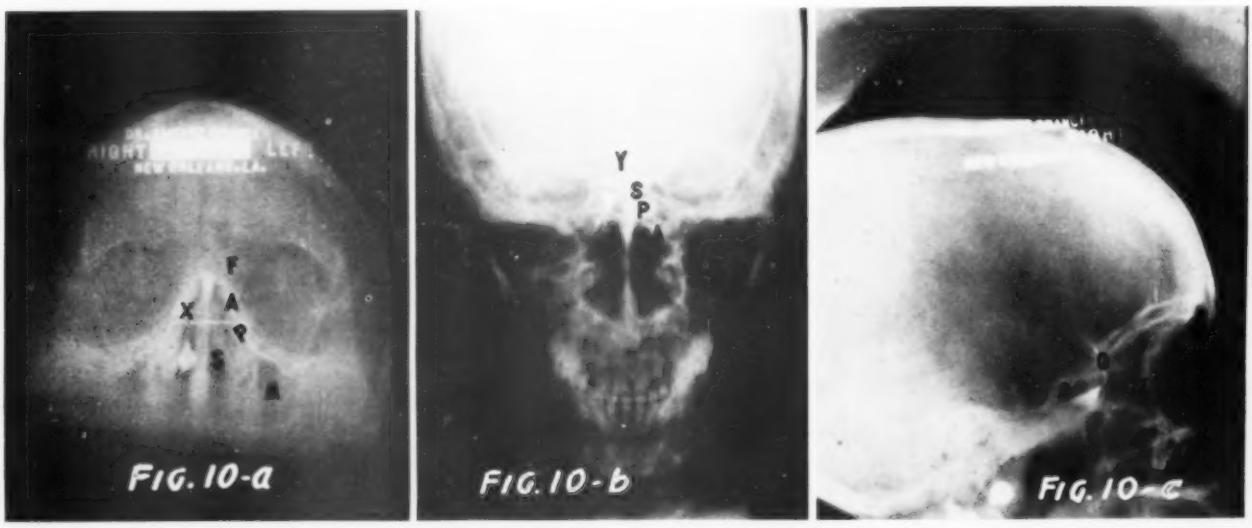

Fig. 10—Right sphenoid sinus of a living subject filled with bismuth paste. (A) Posterior anterior view 23 degree angle: X, upper boundary of sphenoid sinus. (B) Posterior anterior view 107 degree angle: Y, upper boundary of sphenoid sinus. (C) Lateral view: O anterior boundary of sphenoid sinus; Z, boundary line between anterior ethmoid cells and posterior ethmoid cells. S, sphenoid sinus. P, posterior ethmoid cells. A, anterior ethmoid cells. M, maxillary sinus. F, frontal sinus.

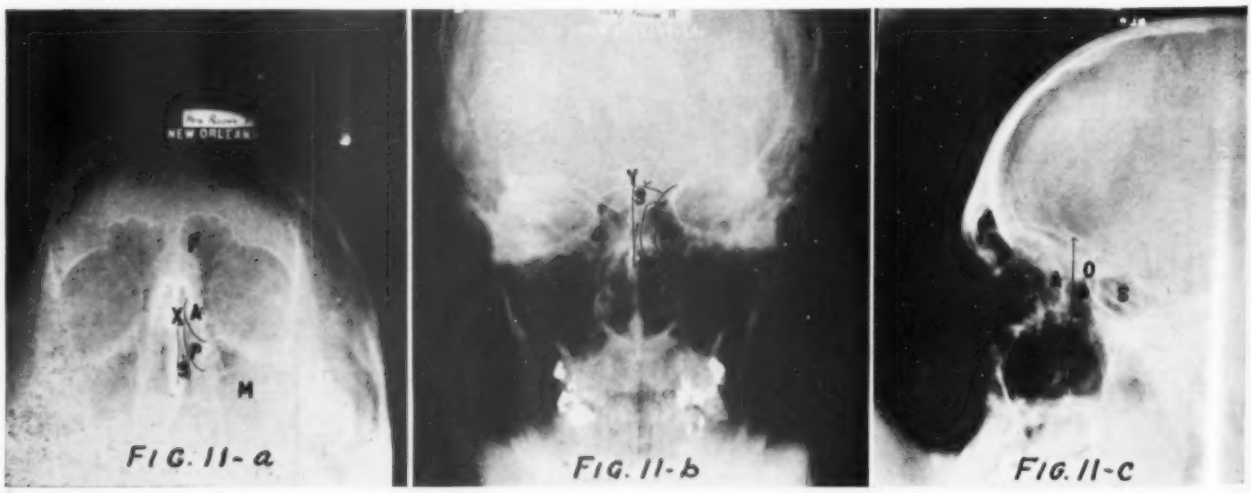

Fig. 11—Normal sinuses in a living subject. (A) Posterior anterior view 23 degree angle: X, upper boundary of sphenoid sinus. (B) Posterior anterior view 107 degree angle: Y, upper boundary of sphenoid sinus. (C) Lateral view: O, anterior boundary of sphenoid sinus; Z, boundary line between the anterior and posterior ethmoid cells. S, sphenoid sinus. P, posterior ethmoid cells. A, anterior ethmoid cells. M, maxillary sinus. F, frontal sinus.

In cases of glioma or other tumor of the base of the brain in the region of the optic groove, besides the changes usually seen in the anterior clinoid process in the lateral view, the 107° angle view should show definite alterations of the curved sphenoid line.

In cases of neoplasm of the sphenoid sinus, besides the changes usually seen in the region of the sella turcica in the lateral view, the 107° angle view should show definite alterations of the curved sphenoid line with changes in the sphenoid region.

The importance of this work can well be attested by the workers in radiology who have been groping their way in the past, by the otolaryngologists who have been disappointed by inadequate and very often inaccurate information furnished them by the roentgenologist,

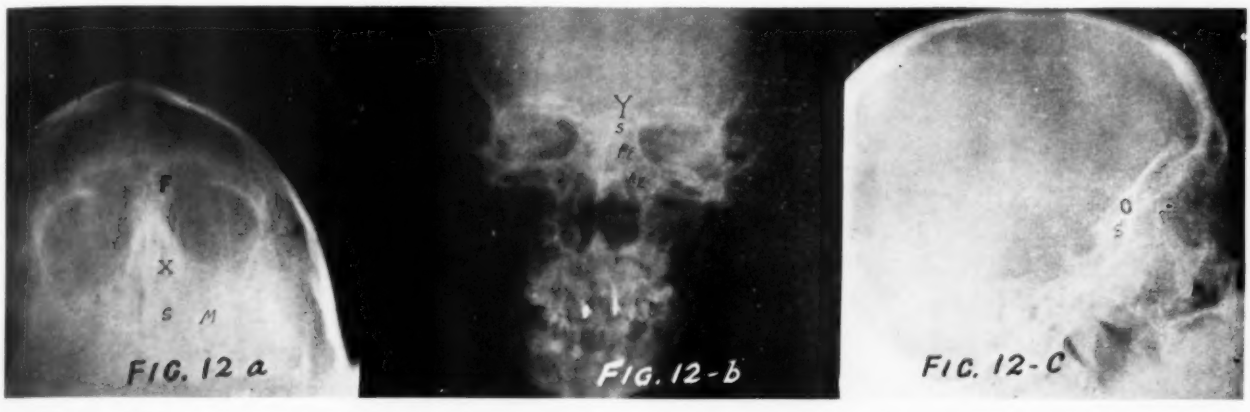

Fig. 12—Left sided chronic sphenoid and ethmoid sinusitis with polypoids. Increased density of the left sphenoid, ethmoid and maxillary sinus regions. curved sphenoid line (Y) not visible on left side.

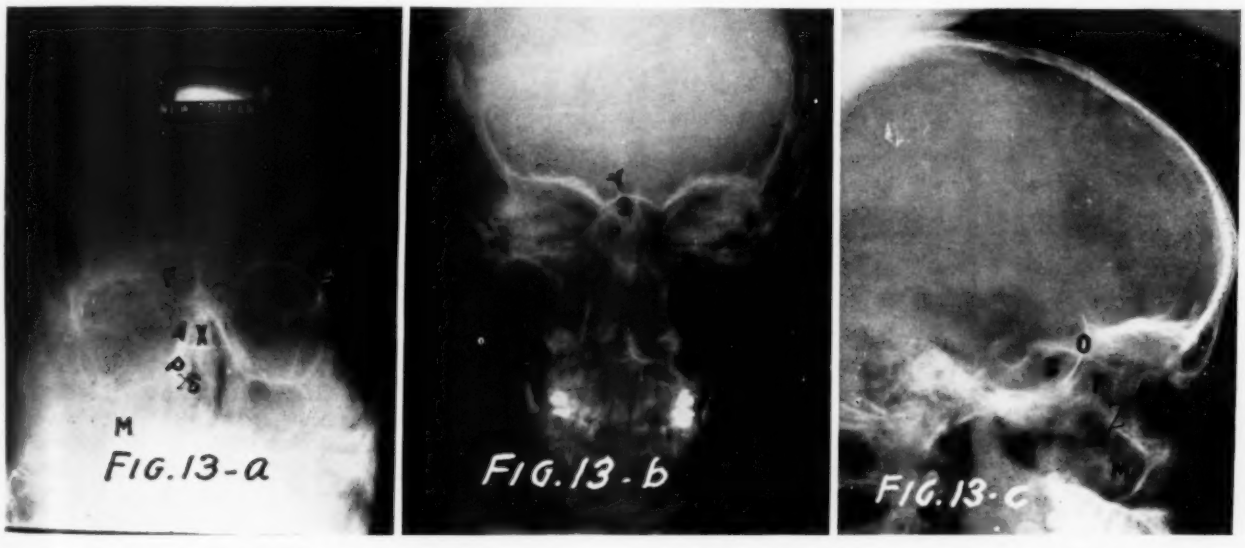

Fig. 13—Chronic pan-sinusitis on the right side. The right side of the line Y is very much thickened, and the sphenoid sinus, the ethmoid cells and the maxillary sinus are all very opaque on the right side.

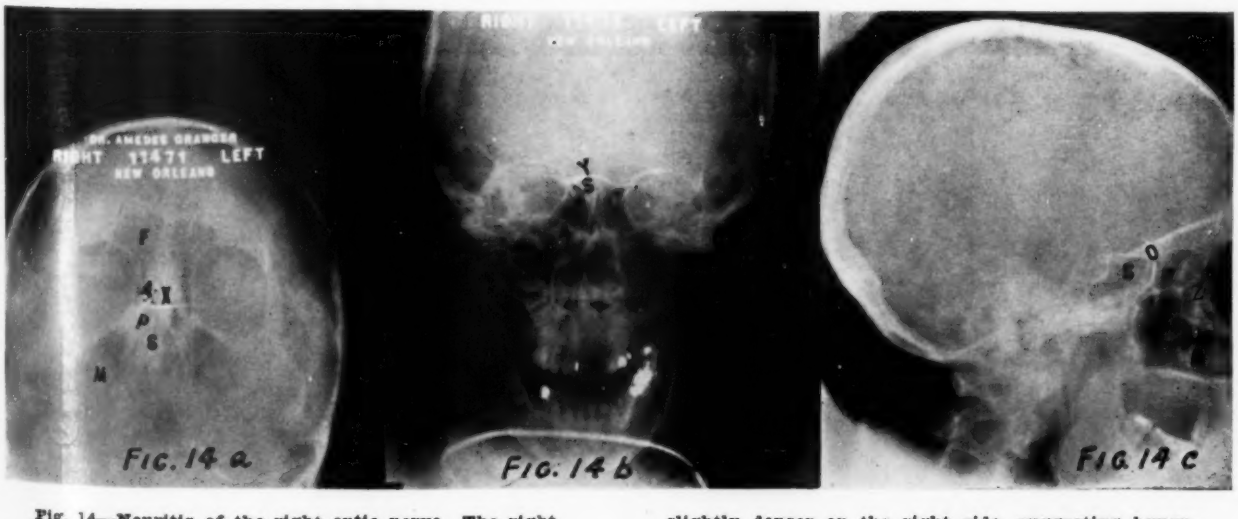

Fig. 14—Neuritis of the right optic nerve. The right half of the curved sphenoid line (Y) is very much thickened, and the sphenoid and ethmoid regions are slightly denser on the right side, suggesting hyperplastic changes.

and more especially by recent statements of such eminent authorities as the late Dr. James Gerritt Van Zwaluwenburg, who said in a paper read before the American Roentgen Ray Society in Washington, "Unilateral sphenoiditis presumably does occur but has not been recognized in this laboratory." And Dr. Greenfield Sluder who in his excellent work, *Concerning Some Headaches and Eye Disorders of Nasal Origin*, says in the chapter on hyperplastic sphenoiditis, "The hyperplastic disease involves not only the bones, but the soft parts covering it, and the hyperplastic bone process with or without periostitis causes thickening of the bone which in turn narrows one or more of the canals through which the cranial nerves pass. When this hyperplastic process involves the outer upper and anterior portion of the sphenoid, it may become localized about the optic canal, often producing impaired vision by pressure from bone extension or by irritation from the proximity of the inflammatory process. Even after removal of the anterior wall of the sphenoid and the introduction of a Holmes pharyngoscope into the sphenoid sinus the forward and backward vision is very limited." In just this class of cases a study of the curved sphenoid line Y would prove of immense service by furnishing very reliable information regarding the condition of the outer-upper-anterior wall of the sphenoid.

1212 Maison Blance Bldg.

X-Rays and X-Ray Apparatus; An Elementary Course*

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II.
The Interrupterless Transformer
(Continued)

15. In Section 10[1] it was stated that the strength of the current flowing through the primary of the transformer might be altered by changing the amount of resistance in the circuit, that is, by moving the rheostat control. By this means the magnitude of the high voltage driving the current through the secondary (the tube) circuit may be altered. This raises certain questions. In any given outfit, what is the value of the high tension voltage? What is the range of voltages which may be obtained? What is the difference between different machines in this respect? Is the rheostat the only means of regulating the actual voltage across the tube? The answer to these and to other questions of the same nature will be given in the paragraphs which follow.

Measurement of High Voltage

16. First of all, then, how is high voltage measured? This may be done in at least four different ways; by means of (1) the spark gap, (2) a voltmeter across the primary terminals of the transformer, (3) the electrostatic voltmeter, (4) the so-called crest meter. Before looking briefly at each method it is well to note that in x-ray work what is invariably wanted is the effective high voltage across the terminals of the tube when it is being used. This is not the same as the maximum voltage (E.M.F.) got up by the transformer.

To utilize the first method, a spark gap consisting of two insulated conductors A and B (Fig. 23) whose distance apart may be varied, is placed in parallel with the tube. With the tube running, the distance between the gap terminals is gradually shortened until a spark takes place. *The length of this spark is a measure of the voltage across the tube or of what is technically called the "back-up" of the tube.* If the length of the gap is initially too great and it is slowly shortened, it should be evident that the "back-up" is a measure of the crest or peak voltage across the tube. (If readings are taken of spark length when tube is not in the circuit, a value of the maximum voltage got up by the transformer is obtained).

It is highly important to note that the sparking distance will depend on the nature of the terminals used. In practice, gaps between points, and gaps between spheres are utilized. Not only are voltage values for equal distances very different in the two cases, but even for sphere gaps, the values vary with the size of the spheres. A glance at Table I (taken from Kaye and Laby's Physical Constants, Edition IV) will show the way in which the spark length

*—Received for publication Jan. 5, 1923.

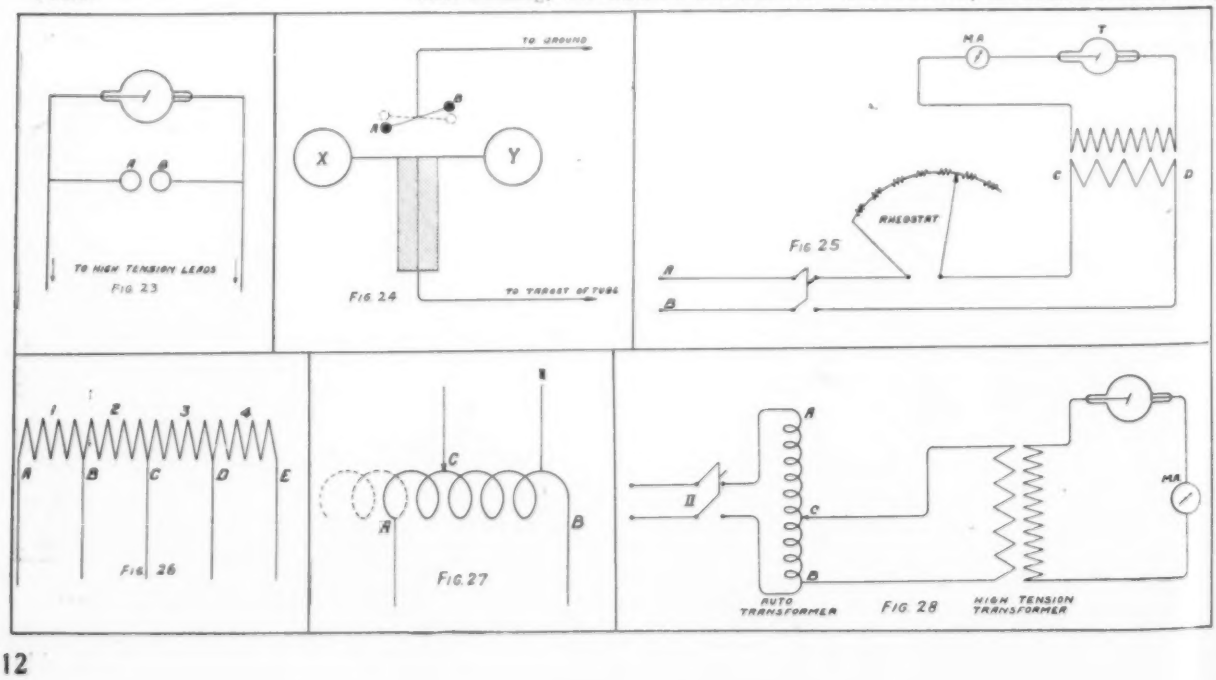

TABLE I.

(Sparking voltages at 25° C and 760 mm. pressure)

Kilo Volts (Peak)	— Needle Points — No. 00 New Sewing Needles		Spheres — Diameter 5 cms.	Diameter 10 cms.	Diameter 25 cms.
	cms. gap.	inches gap.	cms. gap.	cms. gap.	cms. gap.
10	....	....	0.29	0.30	0.32
15	1.30	0.51	0.44	0.46	0.48
20	1.75	0.69	0.60	0.62	0.64
25	2.20	0.87	0.77	0.78	0.81
30	2.69	1.06	0.94	0.95	0.98
35	3.20	1.26	1.12	1.12	1.15
40	3.81	1.50	1.30	1.29	1.32
45	4.49	1.77	1.50	1.47	1.49
50	5.20	2.05	1.71	1.65	1.66
60	6.81	2.68	2.17	2.02	2.01
70	8.81	3.47	2.68	2.42	2.37
80	....	....	3.26	2.84	2.74
90	....	....	3.94	3.28	3.11
100	....	....	4.77	3.75	3.49
110	....	....	5.79	4.25	3.88
120	....	....	....	4.78	4.28
130	....	....	....	5.35	4.69
140	....	....	....	5.97	5.10
150	....	....	....	6.64	5.52
160	....	....	....	7.37	5.95
170	....	....	....	8.16	6.39
180	....	....	....	9.03	6.84
190	....	....	....	10.0	7.30
200	....	....	....	11.1	7.76
210	....	....	....	....	8.24
220	....	....	....	....	8.73
230	....	....	....	....	9.24
240	....	....	....	....	9.76
250	....	....	....	....	10.3

varies for different gaps. It will be noted, too, that for smaller voltages, the change in the distance, for a given change in voltage, is greater in the case of needle points, and for that reason, this kind of gap has an advantage for lower voltages. Its use is not to be recommended, however, because the sparking voltage, for a given distance, varies with variable conditions, such as humidity, sharpness of points, etc. With the very high voltages used in deep therapy, a needle gap is useless. In this case the sphere gap as standardized by the American Institute of Electrical engineers should be used[2]. Provided spheres are used whose diameters exceed that of the spark length, no such inconsistencies exist.

One or two further points, however, should be noted. The voltage corresponding to a given distance varies, not only with the size of the spheres, but also with the atmospheric pressure and air temperature. Table II, for example, shows the correction which must be applied to the values given in Table I. To illustrate, with spheres of diameter 10 cm., at a pressure equal to 740 mm., and temperature equal to 20° C. the voltage corresponding to a distance of 2.02 cm. is not 60,000 but 60,000 times 0.99. Unlike the needle point, however, the sparking voltage for a given distance is independent of the humidity and the frequency (within the limits of values used in commercial A.C.) But because of changing spark length with size of spheres, temperature and pressure, it should be evident that the practice in x-ray work of expressing the voltage across the tube by a spark *length*, even when a standard sphere gap is used, should be discontinued. An accurate comparison of the work of one observer with another is possible only when voltages are expressed in kilovolts.

An objection to the use of a sphere gap must next be noted. With the gap set at a certain distance, a spark will jump whenever the potential difference between the spheres has the corresponding voltage value. This means that should this voltage be attained as a result of only a momentary surge in the circuit, sparking will still occur. Now, it will be seen when we come to the subject of dosage, that this may lead to very erroneous conclusions, for the sudden rise in voltage may last for such a small fraction of the whole half-cycle, that the effect of the x-rays due to it, is almost negligible. To overcome this difficulty, so-called crest meters (See Section 20) which do not respond to these short sudden rises are sometimes used. In spite of this objection, however, the use of a standard sphere gap has much to be said in its favour.

TABLE II.

Temp.	Press. 720 mm.	Press. 740 mm.	Press. 760 mm.	Press. 780 mm.
0° C.	1.04	1.06	1.09	1.12
10	1.00	1.02	1.05	1.08
20	0.96	0.99	1.02	1.04
30	0.93	0.96	0.98	1.01

17. The question of sparking voltages has an important bearing on the use of a rectifier such as was described in Section 8[1]. It was there pointed out that the portion of the rectified half-wave utilized depended on the length of time the revolving metal pieces, 1, 2, 3 and 4 were in contact with the fixed brushes. It should now be evident that *contact will be made as soon as the voltage is high enough to cause a spark to jump across the gap between the brush and the rotating part.* Since in the type of rectifier described (and most others) the metal pieces have sharp corners, it follows that we are here concerned with sparking between points. This means that there is much uncertainty about the exact portion of the half wave which is utilized. Indeed there will be in general a variation with conditions, both electrical and atmospheric. Now, for ordinary radiographic purposes this may have no serious consequence; in deep therapy, however, as will be seen later, it is important to use always the same portion of the half-wave (and that the smallest possible). To meet this need, a so-called *constant rectifier* has been placed on the market. The principle utilized is exactly the same as that already described, but brushes in the form of spheres, and thick revolving parts with smooth curved surfaces, are used so that sparking occurs essentially between spheres. By this means all the uncertainties of sparking between points are eliminated. A description of such a rectifier will be found in a pamphlet, *A Precision X-Ray Apparatus*, by Montford Morrison, of the Acme X-Ray Company, Chicago.

18. A second means of measuring the "back-up" of a tube is found in the use of an ordinary A.C. voltmeter across the primary terminals of the high tension transformer. As the primary voltage changes, so, too, will the high tension voltage. Accordingly, for any given machine, the ordinary voltmeter may be calibrated once for all, and an exact relation obtained between its

readings and the high voltage across the tube. To do so, it is necessary to utilize a standard sphere gap and to take simultaneous readings of back-up and of primary voltmeter. Unfortunately, to quote from a recent article[3] by Dr. W. D. Coolidge and W. K. Kearsley, "The primary voltage required to produce a given high tension voltage will depend on the milliamperage (that is, on the current through the tube). It is then necessary to calibrate against the sphere-gap for the exact milliamperage which is to be employed." Another objection to this method is found in the fact that a very slight change in the primary voltage may mean a considerable change in the high tension voltage, although by proper design of the transformer this may be minimized to some extent. In spite of these objections a primary voltmeter, accompanied by a calibration table for different milliamperages, should be useful.

ELECTROSTATIC VOLTMETER.

19. The fundamental principle involved in the use of electrostatic voltmeters may be described by giving the details of one used by Dr. William Duane of Harvard University. This instrument consists essentially of a fixed part, two large metal spheres X and Y (Fig. 24) mounted on a highly insulated support, and a movable part, consisting of two metal balls A and B suspended so as to be free to rotate about a vertical axis. In using the instrument one side of the tube is joined to earth (grounded) while the other side (the target) is joined to the insulated metal balls of the instrument. As the movable balls are joined to earth, there exists between the fixed and the movable parts of the voltmeter, the same potential difference as between the two sides of the tube. The part AB rotates an amount which depends on this difference of potential, hence the magnitude of the latter is obtained by reading the deflection. It is, of course, necessary to calibrate the instrument by comparison with a standard sphere gap, or by using known high voltages such as were available for Dr. Duane.

(In passing it may be noted that the Bauer qualimeter, an instrument used to measure the penetrating power of x-rays—to be discussed later—is essentially an electrostatic voltmeter).

THE CREST METER

20. To avoid the error in connection with the use of a standard sphere gap when momentary surges in the voltage occur, the use of the so-called *crest meter* has been recommended. In this instrument use is made of the means originally employed by Fortescue and Chubb[4] for calibrating fundamentally a sphere gap. An air condenser (See Section 33) is charged by the high voltage (to be measured) across the tube and the charge stored in the condenser is discharged through a galvanometer. Now, since for the same condenser, the current (when the condenser is rapidly charged and discharged) is proportional to the voltage to which it is charged, it follows that the deflection of the galvanometer is proportional to the voltage. Accordingly, with such an arrangement the scale on the galvanometer may be marked so as to read the number of kilovolts across the tube. It has the great advantage that at all times during the operation of the apparatus, the voltage across the tube is known. Further details in connection with such an instrument will be found in the article by Montford Morrison to which reference has already been made.

"CAPACITY" OF AN X-RAY OUTFIT.

21. It is important for the reader to realize that the transformer is a means of supplying electrical energy to the x-ray tube. Now the actual amount of electrical energy supplied any portion of an electric circuit depends on three quantities: (1) the voltage, (2) the current, (3) the time[5]. Since the time factor is so readily taken care of, usually we consider the energy supplied per second or what is known as *the power*, which obviously, then, depends on the voltage and the current. [Compare the power available from a water-fall which depends on (1) the head of water, (2) the quantity of water coming over the fall per second. One million gallons falling from a height of 50 feet represent the same power as half a million gallons from a height of 100 feet.] To be more definite, when a current of 1 ampere is flowing in a portion of a circuit under a potential difference of 1 volt, the power is 1 volt-ampere or 1 watt. (746 watts equal 1 horsepower.) If 50 amperes flow under a potential difference of 110 volts, the power is 50 × 110 or 5500 watts. An electric toaster consuming 550 watts when operated on 110 volts has a current of 5 amperes flowing through it. When, therefore, the voltage used to drive 10 milliamperes through an x-ray tube is 20,000 volts, the power supplied the tube is proportional to 10/1000 × 20,000 or 200 watts. The product does not give the exact value of the power in watts because although the current may be the correct average value, the voltage value in general is not the average, but probably the maximum (crest) value during a half cycle. Generally speaking, however, *we may compare the amounts of energy supplied a tube each second under different conditions by comparing the products of the effective crest voltage between its terminals times the current flowing through it.*

Now the so-called "capacity" of an outfit refers to the maximum energy

FIG. 29

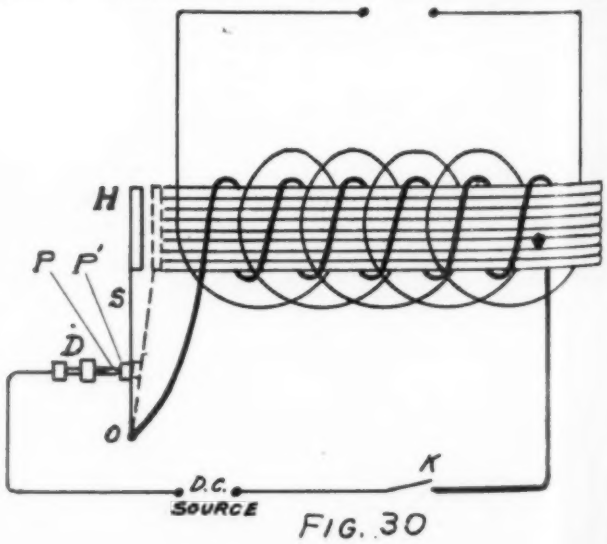

FIG. 30

per second it is capable of supplying an x-ray tube. (The word "capacity" is not a very happy one, as in electrical science capacity has a very definite and distinctly different meaning. See Section 33.) It is usually expressed by giving the value of the maximum current which can be supplied a tube, under a specified "back-up." For example, in advertising literature one finds statements such as the following: A certain unit is "capable of energizing the 30 ma. 5-inch Coolidge Tube;" the output of another is "rated at 250 ma. at a 6-inch back-up between points." Such statements do not mean that the transformer may not be able to maintain a much higher voltage across a tube than the one stated. For example, in connection with the second of these outfits, the catalogue states further that "the *maximum* spark gap between points is 12 inches." Should higher voltages (than those corresponding to a 6-inch gap) be utilized, a correspondingly smaller current would be supplied, because, once more, the energy supplied depends on both the current and the voltage, and in this case, cannot exceed an amount proportional to the product (250 ma. times voltage corresponding to a 6-inch gap between points). Occasionally one sees advertised a machine capable of giving, say, a 20-inch spark, with no mention of the current. It should be evident that such a statement does not give all the necessary information, unless, indeed, it is assumed that at such a voltage only very small milliamperages will be used.

22. The capacity of an x-ray unit is sometimes expressed in terms of the maximum power which may safely be supplied the primary of the high tension transformer. For example, a machine is sometimes advertised as having a capacity of 5 kw. (5 kilowatts = 5000 watts). This means that, if operated on 220 volts, primary currents as high as 5000/220 or over 22 amperes may be utilized[6]. Since there is very little loss of energy in a good transformer, a 5 kw. unit can deliver nearly that same amount on the high tension side. It does not give, however, any information regarding the value of the highest voltage which may be generated, since, as noted in section 7[1], this depends on the ratio of the number of turns of the secondary coil to that of the primary.

23. In passing we may note that, quite apart from the capacity of the high voltage generating outfit, an x-ray tube has a maximum capacity. The 7-inch Coolidge tube, for example, is capable of carrying continuously about 1 kilowatt. Later, in discussing the action of the gas and the Coolidge tubes, details in connection with this question will be considered, but it is well to note here that it is again simply a question of how much energy per second it is safe to supply the tube.

Control of Back-Up.

24. In Section 21 reference was made to a machine with a capacity of 250 ma. at 6-inch back-up, capable also of generating a maximum voltage corresponding to a 12-inch gap. With this machine, as with all others, there is evidently a range over which different voltages may be utilized. How, then, we next ask, is an operator able to alter the voltage available for the tube circuit? Three different means are utilized: (1) the rheostat, (2) primary convolutions, (3) the auto-transformer.

(1) *The Rheostat*—Reference has been made already to the use of the rheostat. One or two further points should be noted. Whenever a current has to flow against resistance, heat results (compare motion against friction) and there is a certain loss of power. Moreover, since voltage is necessary to cause the flow of a current against resistance, *there is always a drop in voltage along a line containing resistance.* The magnitude of this voltage drop depends both on the current and the resistance—the greater each of them, the greater the drop. It follows, therefore, that if, at the main leads A and B (Fig. 25), there is a supply of say 110 volts, the voltage across C and D, the terminals of the primary of the high tension transformer is less than 110 by an amount which depends on the resistance utilized in the rheostat and the current strength. In the case of the gas bulb, this has a decided advantage over the auto-transformer control (See "3" of this section). Suppose the resistance of a gas bulb T (Fig. 25) suddenly lowers. (For reasons to be given later this may happen). This means that the high secondary voltage at once causes a greater current in the tube circuit, and consequently automatically a greater current flows through the primary (to supply the necessary energy). Since, however, a rheostat is in the primary circuit, *this current increase means an increase in the voltage drop through the rheostat, and therefore the voltage applied to the primary of the transformer lowers.* As a result of this, the high tension voltage will lower also, hence the tube current will lower again. In this way a rheostat acts as a kind of safety valve preventing a sudden increase of current beyond the capacity of the outfit. This is not so in the case of the auto-transformer.

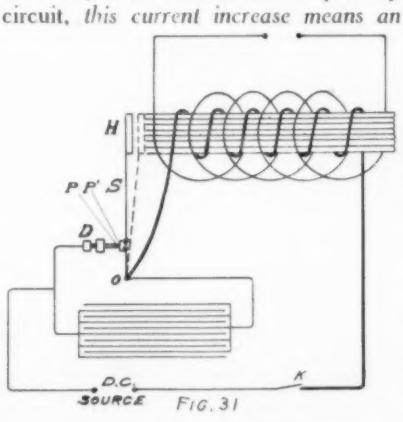

FIG. 31

(2) *Convolutions*—In some units the rheostat is supplemented by an additional control in the form of what are called convolutions. This simply means that the primary coil is wound in sections, so that different numbers of turns in the primary may be utilized. For example in Figure 26, it is evident that by using terminals A and C, sections 1 and 2 of the transformer would be utilized; by using A and D, sections 1, 2, and 3 would be utilized, and so on. By such means the ratio between the number of turns of the primary and that of the secondary may be altered by steps and in this way the maximum high tension voltage changed by corresponding amounts. In one catalogue, the writer has seen a machine advertised with convolutions so arranged that voltages of 25, 45, 65, 80 and 100 thousand may be obtained. By using a rheostat on the line in the usual way, a finer control of high tension voltages is possible and intermediate value may readily be obtained.

(3) *The Auto-Transformer*—This is practically a transformer with only the primary winding, or, one where the same coil serves both as primary and secondary. Suppose (Fig. 27) AB represents such a coil, with the usual iron core not shown. Then if 110 volts A. C. are applied to the coil across AB, between the end B and some intermediate point C, there will be a voltage whose magnitude bears the same relation to 110 as the number of turns between B and C is to the total number of turns between A and B. If, therefore, C is a sliding contact, any voltage between 0 and 110 may be obtained by altering the position of C. (If the coil is extended as indicated by the dotted lines, it is possible to obtain voltages higher than 110.) When, therefore, an auto-transformer control is used in an x-ray outfit, connections are made as illustrated in Figure 28. On closing x-ray switch II, 110 (or 220) volts are applied across the auto-transformer; a different voltage, whose magnitude depends on the position of the variable contact C, and is equal to 110 multiplied by the number of turns in BC divided by the number of turns in AB is at once applied to the primary of the high tension transformer, and in the usual way, the induced high

voltage causes a current through the tube circuit.

A comparison of the action of the auto-transformer with the rheostat may be obtained best by imagining again that the resistance of the tube suddenly lowers. In this case, the high tension voltage at once causes a greater tube current; automatically the primary supplies more power (a greater current) while a greater current must also be supplied the auto-transformer. In this case, however, the voltage applied to the *primary* (that is, the voltage between A and B) does *not lower*. Consequently the high tension voltage does not lower, and it is quite possible that the suddenly lowering of tube resistance may result in current values increasing far beyond those safe for the apparatus, with consequent damage. Accordingly, whenever there is danger of the tube resistance lowering (as in the gas bulb), the auto-transformer control is not desirable. It may, however, be used in conjunction with a rheostat. Figure 29, for the original electrotype of which my thanks are due the Victor Electric Corporation, is a photograph of the actual control board of an x-ray unit. On the left may be seen two swinging arm controls, one of which regulates the rheostat, the other an auto-transformer.

In the case of a Coolidge tube, as will be seen later, no sudden lowering of tube resistance is possible, and the auto-transformer may be used with advantage. With it, for any given position of the variable contact C, a constant voltage is applied to the primary of the high tension transformer. The high tension voltage, therefore, has a constant value, an important consideration where x-rays are used for treatment. In the case of the auto-transformer, moreover, there is not the loss of power noted above in the use of a rheostat. Finally, to quote from literature of the General Electric Company, Schenectady, N. Y., "in diagnostic work, it has been found that it is almost impossible to obtain duplication of results when a series resistance control is employed for this purpose. We recommend that an auto-transformer be used for control for all diagnostic work and resistance control for therapeutic work." (This remark refers to the Coolidge tube.)

CIRCUIT BREAKER.

25. This is a device added so that the circuit may be automatically broken should, for any reason, the current strength (the load) exceed the capacity of the outfit. This might happen, for example, in the case of a gas tube and auto-transformer control, or again because of the accidental short-circuiting of the high tension circuit. The principle underlying the use of many circuit breakers is briefly the following. In the circuit is placed an electro-magnet which exerts an attraction on a piece of soft iron near it. When the current exceeds a certain strength, the attraction is sufficient to move the soft iron and so cause the opening of a switch in mechanical connection with it.

ROTARY CONVERTER: MOTOR GENERATOR

26. From the description of the interrupterless transformer which has been given, it should be evident that an alternating current is necessary. Supposing only a supply of direct current is available, what then? In that case, some kind of additional apparatus for obtaining alternating current is necessary. One may use a *motor-generator* set, that is, a combination of a motor, in this case to run on D. C. (direct current) and a generator which is rotated by the motor and "generates" the desired A. C. One may also use a *rotary converter*, which is a single machine by means of which D. C. may be supplied at one side, and A. C. taken off at the other (or vice versa). The general principles of the high tension outfit for D. C. supply, are otherwise the same as described above, except that when a rotary converter is used, a synchronous motor is not necessary. The rectifying disc is turned by the converter at the proper speed, because it supplies the alternating current delivered to the transformer.

27. Another way in which a source of D. C. may be utilized for obtaining high voltages, is found in the use of the induction coil, the second of the two methods noted in Section 11. Although in North America the transformer is used almost to the exclusion of the coil, the latter is by no means obsolete, and a detailed consideration of the principle underlying its construction and use is desirable.

III.

THE INDUCTION COIL.

28. In the coil, as in the transformer, the principle of electro-magnetic induction is utilized. Indeed the induction coil is a modified form of transformer. A direct current flowing through a primary coil wrapped about an iron core is regularly made and broken. The magnetic lines of force, therefore, which traverse the iron core, regularly appear and disappear, and, in consequence, there are induced electro-motive forces (E.M.F.) in a secondary coil wrapped over the primary. On "make" of the primary current the induced high voltage is in one sense, on "break" in the opposite. By making the number of turns of the secondary many times greater than that of the primary, very high voltages may be obtained just as in the case of the transformer.

29. To make and break the current regularly what is called an *interrupter* is used. There are three types of these in general use (a) the hammer, (b) the mercury jet, (c) the electrolytic or Wehnelt. Some details in connection with each of these will be noted. First of all, however, the action of the coil will be discussed with reference to one fitted with a hammer break, the kind in general use on small coils. Figure 30 represents a primary coil wrapped about a bundle of iron rods which constitute the (open) core of this type of transformer. The coil is supplied with current from some D. C. source (such as a number of storage batteries, or, in the case of large coils, the supply terminals joined to a direct current generator), connections being made as shown

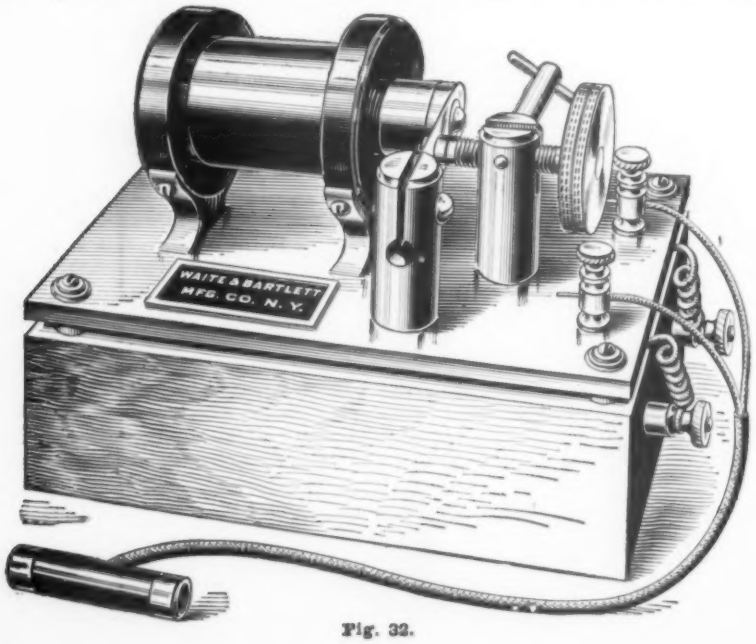

Fig. 32.

in the diagram. P represents a contact point made of a metal such at platinum, attached to the end of a screw passing through a rigid support D. H is a piece of soft iron (the hammer) at the end of a steel spring S, the other end of which is rigidly fastened at O. Normally (that is, when no current is flowing) the platinum point P touches a small piece of platinum P′ attached to the spring. Now suppose the switch K is closed. A current then flows because there is a complete circuit from one terminal of the source through the coil to 0 to P′ to P and back to the other terminal of the source. This current magnetizes the iron core, which accordingly attracts the hammer pulling it to the dotted position. This movement of the hammer breaks the contact between P and P′; the current therefore, ceases to flow; the core loses its magnetism; the hammer, being no longer attracted, flies back and in so doing brings the contact points P and P′ together again, and so closes the circuit. The action is then repeated. As long, therefore, as K is left closed, with such a device the primary current is *automatically* made and broken. Hence if a secondary coil is wrapped about the primary, there will be induced in it a high electro-motive force, in one sense on make, in the opposite on break.

30. Now what about the *magnitude* of the high voltage which may be obtained in this way, and in particular, what about the relative magnitude of that obtained on make as compared with break? To understand the answer to these questions, it is necessary to remember that the magnitude of any induced E.M.F. (see Section 5[1]) depends on both the total change in the number of lines linked with the circuit and the time in which the change takes place. By having a strongly magnetized core and many turns in the secondary, therefore, very high voltages may be obtained provided the time of either make or break is very short. Now as a matter of fact in building a good coil, one of the chief aims of the maker is to make the time of break so many times less than that of make, that the induced voltage obtained on make may almost be neglected in comparison with that of break. In other words, a good coil is able to deliver a current which is practically uni-directional through a tube. To explain why the time of break is so much shorter involves a consideration of one or two further points.

INDUCTANCE.

31. The effect of having a large inductance in the circuit must be clearly understood. Suppose a simple circuit contains a battery or some D. C. supply and an electro-magnet. When a current is flowing, a large number of magnetic lines are linked with the turns of the electro-magnet, and we say the circuit has a high *inductance*. Practically the inductance is measured by the number of lines linked with the circuit (due regard being taken of the number of turns) when a current of one ampere is flowing through the coil. Consider now what happens during the short time in which the current rises from zero to its final steady value. As the current increases, more and more lines are being introduced and so there is continually a change in the number linked with the turns of the electro-magnet. By the principle of electro-magnetic induction, therefore, there will be an induced E. M. F. in this coil itself. This is a self-induced E. M. F. or better the E. M. F. of inductance. Now the direction of any induced E. M. F. is always such as to oppose the change causing it. In this case, therefore, the effect of inductance is to set up a voltage (E. M. F.) opposed to the applied voltage (of the battery) and in consequence, to cause a delay in the rise of the current to its steady value. In other words, the effect of inductance in a D. C. circuit is to prolong the time it takes for current to rise to its steady value. Similarly, if a circuit containing inductance is broken, during the time in which the current is falling to its zero value, there is continually a change (in this case a decrease) in the number of lines linked with the circuit, and again an E.M.F. due to inductance. Again, the inductance E.M.F. opposes the change and unless the circuit is broken in a special way (See Section 33) it prolongs the time of break for the following reason. The actual magnitude of the inductance E. M. F. is generally so great that when a circuit is broken it results in a spark jumping across the gap where the break is made. For a short time, therefore, a conducting path is established at the contacts. Any one who has ever broken a circuit containing an electro-magnet cannot fail to have observed the spark which takes place, on break, at the switch used to break the circuit. *To sum up, then, with a large inductance in a circuit, the time of make is prolonged, while unless special precautions are taken, at break, a spark will jump the break gap and so prolong the time of break.*

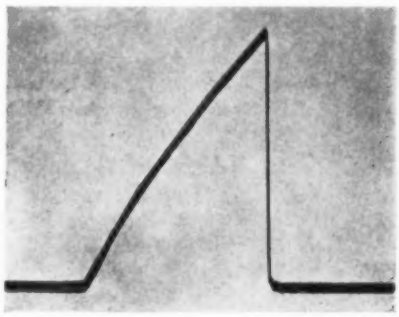

Fig. 33.

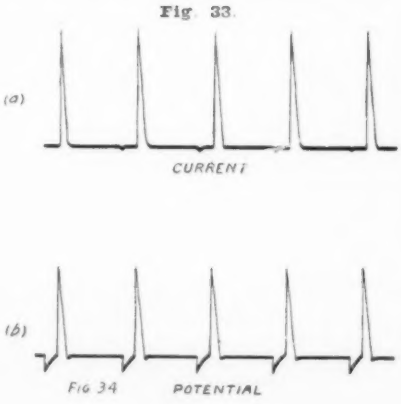

FIG 34

Now, obviously, once a circuit is closed, we have no further control over it. The time of rise depends on the amount of inductance and the general arrangement of the circuit. When a circuit is broken, however, the time of break depends on the mechanical means used to break the circuit. If, for example, it is broken by firing a bullet and so breaking a wire (this has actually been done) the time of break is very short, so short indeed, that the two parts where the break occurs are separated so quickly that there is no chance for the spark to jump across.

32. Now let us apply this idea of the last section to the arrangement of Figure 30. In this case the hammer is pulled back by the elasticity of the spring, and the time of break is not short enough to prevent a spark jumping across the contact points. The time of break, therefore (as well as make), is not sufficiently short to give a high voltage, and such an arrangement would be of little use for a practical coil. Moreover, a large percentage of the energy which is stored up in the magnetic field (almost the whole of which in an ideal coil is transformed into the energy of the induced current in the secondary coil) appears in the spark or possibly the arc, which occurs at the contact points.

33. To secure the necessary short time of break, a *condenser* must be placed across the contact points P and P′, as illustrated in Figure 31. The form of condenser used consists of two sets of tin foil, each of many sheets, separated by some dielectric, often paraffined sheets of paper. This arrangement of conductors has what is technically called a high *capacity* (here the word is used in its accurate scientific sense) by which it is meant that, before the potential difference (voltage) between the two sets of plates can rise to values great enough to cause a spark discharge to take place through the paper, an enormous quantity of

electricity must be on each set (positive on one, negative on the other). What, now, is the effect of placing a condenser across the contact points? Briefly it is somewhat as follows: When the switch K is closed, and the primary current begins to rise, a certain quantity of electricity will flow into the condenser, one set of plates becoming positively charged, the other negatively. Consequently the first effect of the condenser is to delay still further the time of make. When the primary current has magnetized the iron core sufficiently, the hammer is attracted and the points separate. Because of the condenser, however (and here we have a second advantage) little sparking occurs at the points, for the E. M. F. of inductance causes a further charging of the condenser. Arcing, therefore, does not prolong the time of break, and for that reason there is much less loss of energy due to this cause. (The energy corresponding to the charging of the condenser is re-gained when the condenser immediately discharges back through the primary coil).

To sum up, then, a condenser lengthens the time of make, shortens the time of break and prevents much of the sparking and arcing at contact points. It is possible, therefore, by using such a device to build up a coil whose high tension voltage on break is enormously greater than on make. There is, however, always some induced voltage at make, and herein lies one of the drawbacks of the coil. Some means must be utilized to get rid of the current due to this reverse or, as it is generally called, inverse voltage. Such means are discussed in the next article.

34. In actual practice, the condenser has to be adjusted to suit the particular primary coil utilized, because the maximum high voltage generated depends greatly on the actual capacity of the condenser. It has been shown, for example, that by changing nothing but the capacity, the maximum potential of a given coil could be changed as much as two and one-half times. The same coil, moreover, is not adapted for use under a variety of conditions. To quote from Knox, the eminent English radiologist, "it is far better to have several coils built for special purposes than to endeavor to achieve with one coil the same results under varying conditions of interrupter."

In larger coils operated by means of a hammer break, the interrupter is often on a separate mounting, a small electromagnet being used to attract the hammer. Figure 32 is an illustration of such an interrupter. For the cut of this figure my thanks are due the Waite and Bartlett Company, New York.

FARADIC CURRENTS: FARADISATION

35. Figure 33 is a reproduction of an actual photograph (due to Salomonson) of a record of the primary current during a single make and break. The comparatively slow rise to a maximum followed by a quick drop is clearly shown in the illustration.

If records are made of the current in the secondary (when an x-ray tube is in the circuit) as well as of the secondary voltage, curves somewhat similar to those shown in Figure 34 are obtained. In (b) the fairly large inverse voltage is clearly shown, while in (a) the resulting slight inverse current can be detected. The exact nature of these curves will vary with the conditions and in general they are not quite so simple as those represented in Figure 34. These graphs, however, represent correctly the general nature of what are called *faradic* currents. In so-called *faradisation* use is made of these currents. It will be seen that they are characterized by sudden abrupt changes of current and of potential markedly different from the smooth, gradual changes of sinusoidal currents. The *secondary faradic*, as its name implies, refers to the use of the secondary of a coil. In the *primary faradic* use is made of the E. M. F. of inductance which has been discussed in Section 31. By placing across the contact points leads connected to the patient, on each break, a sudden stimulus is received.

REFERENCES.

1. In the first installment of this series of articles the numbers of sections were not printed. The numbers for the headings of the author's article published in February are as follows:

Section 1. — The Interrupterless Transformer, p. 51.

Sec. 2.—The Volt, p. 51.

Sec. 3.—The Principles of Electromagnetism, p. 52.

Sec. 4.—The Principle of Electromagnetic Induction, p. 53.

Sec. 5.—Magnitude of Induced Voltage, p. 53.

Sec. 6.—Meaning of A. C. Sinusoidal, p. 53.

Sec. 7.—The High Tension Transformer, p. 54.

Sec. 8.—Necessity of Rectification, p. 54.

Sec. 9.—The Synchronous Motor, p. 56.

Sec. 10.—A Simplified Interrupterless Transformer, p. 56.

Sec. 11.—Direction of Current Through the Tube, p. 56.

Sec. 12.—The Polarity Indicator, p. 56.

Sec. 13.—The Foot Switch, p. 57.

Sec. 14—Last paragraph, p. 57.

2. See Standardization Rules of American Institute of Electrical Engineers.

3. Coolidge & Kearsley, Am. J. Roentgenol. 9:77, Feb., 1922.

4. Fortescue & Chubb, Proceedings of Am. Institute of Electrical Engineers. 31:739, 1913.

5. When alternating current is supplied a portion of a circuit containing inductance (See Section 31) the energy depends also on another quantity called the power factor. The amount of energy is still, however, proportional to the product volt-amperes-time.

6. Because of the power factor the current might be much more than 22 amperes.

ERRATA

In addition to the error noted in reference No. 1, above, it should be noted that on page 53 of the February Journal, in the paragraph, "The Principle of Electro-Magnetic Induction," the sentence beginning, "If now the wire A B is moved from" etc., *should read: "If now the wire A B is moved from position I across the lines of force to position II (A' B') a momentary current will be indicated by G, the measuring instrument. If the wire be moved back again a momentary current in the opposite direction is recorded."*

Also in the last line of the first column, p. 53, "A' B'" *should read A B.*

Further, under "Magnitude of Induced Voltage," second column, p. 53, the arabic figure "(1)" *should read* (2).

Bone Tumors: Sarcoma. Periosteal Group. Ossifying Type Benign Ossifying Periostitis and Myositis*

JOSEPH COLT BLOODGOOD, M. D.
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Osteosarcoma.
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Case 1.—Pathol. No. 30616.—Periosteal sarcoma of ossifying type; shaft of femur below trochanter. Palpates like benign bony growth; two exploratory incisions for diagnosis before amputation. (Figures 1 to 5).

Case 2.—Pathol. No. 32122.—Excessive ossifying type of periosteal sarcoma of upper end of tibia; ossifying metastatic tumors in lung. Reported by Dr. Le Count of Chicago.

Case 3.—Pathol. No. 29638.—Benign ossifying periosteal tumor of neck of femur. (Figure 6).

Case 4.—Pathol. No. 23284.—Excessive ossifying periosteal sarcoma; possibly sarcoma in old ossifying myositis. Death from metastasis to lungs. (Figures 7 and 8).

Case 5.—Pathol. No. 32020.—Benign excessive ossifying periostitis or myositis in amputated stump of femur six years after amputation. Patient of Dr. Baer of Baltimore. (Figures 9 and 10).

Case 6.—Pathol. No. 15283.—Benign excessive ossification of stump after amputation of femur for osteomyelitis (Figure 11).

Case 7.—Pathol. No. 27702.—Excessive bone formation in leg after resection of upper third of fibula for a benign periosteal ossifying growth. Patient of Dr. Le Conte of Philadelphia. (Figures 12, 13, 14 and 15).

Case 8.—Pathol. No. 800.—Benign osteoma or ossifying myositis surrounding the upper third of the humerus. Diagnosed in 1894 ossifying sarcoma. Amputation. (Figures 16, 17, 18 and 19).

OSTEOSARCOMA

I have not had the time to read back as to the original meaning of the term osteo or osteoid sarcoma. I have always been of the opinion that it was first employed to mean a sarcoma arising from bone and not necessarily a bone-forming sarcoma. But, unfortunately, this term has been employed in more recent literature to mean both a tumor arising from bone and a sarcoma containing new bone formation.

OSSIFYING TYPE

Because of the ambiguity of osteo or osteoid sarcoma we need a new term to describe that type of sarcoma in which bone formation predominates, and it seems to me that the word "ossifying" cannot be misunderstood. There is a benign ossifying periostitis and a benign ossifying myositis, and there is also an ossifying sarcoma. The latter, in my experience, has always been periosteal. For this reason I suggest *ossifying sarcoma* to be employed for those periosteal sarcomas in which ossification, both in the x-ray and in the gross and microscopic appearances, predominates in the picture.

CENTRAL SARCOMA

There is a group of bone lesions in which for varying periods there remains an intact bone shell covered with normal periosteum. This bone shell can be seen clearly in the x-ray, and, when one explores the lesion, as I have on many occasions, one finds uninfiltrated normal soft parts, an unthickened periosteum, and this periosteum strips back sometimes exactly like normal periosteum, in other cases it seems looser. The bone beneath may be normal, that is, white and opaque, and when the periosteum is stripped back from each Haversian canal into which the connective tissue of the periosteum dips, a minute drop of blood will appear. The first change from normal in the bone shell is that this bleeding from the Haversian canals is absent, and the bone beneath has lost its white, glistening, opaque appearance and is dark, somewhat like the bark of a tree.

The thickness of the bone shell may vary up to the thinness of parchment. When one palpates the bone shell it may feel like normal bone, it may be slightly rough, or it may give parchment crepitation. In the Journal of Radiology for March, 1920, I discussed and illustrated the types of central lesions. In that article, Figure 1 (Pathol. No. 19133) shows the x-ray of a central myxosarcoma, while Figure 2 (Pathol.

Fig. 1—Pathol. No. 30616. Case 1. X-ray (6/9/22) of periosteal sarcoma of the ossifying type. This bony tumor palpates like bone.

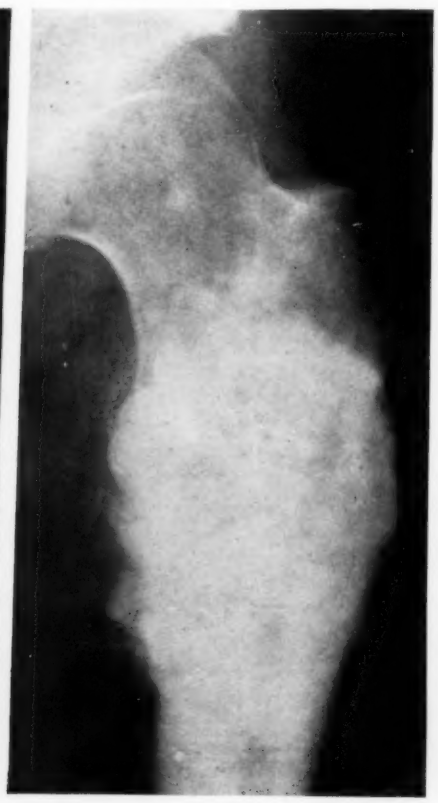

Fig. 2—Pathol. No. 30616. Case 1. X-ray (9/5/22) of periosteal sarcoma of ossifying type. This bony tumor palpates like bone.

*—Received for publication February 3, 1923. (Reprint No. 120).

No. 17871) shows a benign cyst of the greater trochanter. Figure 5 (Pathol. No. 16297) is a benign bone cyst of the upper end of the tibia; Figure 15 (Pathol. No. 22016) a central chondroma of the lower end of the femur, and Figure 16 (Pathol. No. 25778) a central giant-cell tumor of the lower end of the femur, while Figure 20 (Pathol. No. 14229) is a central sarcoma; Figure 28 (Pathol. No. 22929) a central myxoma; Figure 37 (Pathol. No. 23552) illustrates that tuberculosis may appear as a central bone lesion with an intact bone shell. Up to the present time I have never observed syphilis or pyogenic osteomyelitis to appear as a central bone lesion with an intact bone shell without evidence of an ossifying periostitis. The remarkable feature of the central bone lesion as discussed and pictured in the Journal of Radiology for March, 1920, and again in Minnesota Medicine[1] is the absence of any ossifying periostitis in the bone shell about these central lesions, whether they be benign or malignant. It is also true that in multiple myeloma and in metastatic carcinoma, especially from a hypernephroma, we may have a central bone lesion with an intact bone shell without evidence of ossifying periostitis.

Fig. 3—Pathol. No. 30616. Case 1. Periosteal sarcoma, ossifying type. Photograph of pieces of bone removed at exploratory excision. For microscopic picture see Figure 4.

Fracture in Central Bone Lesions

This may occur in every type of central bone lesion; the fracture may heal with just sufficient ossification for union, but ossification never takes place in the central lesion, except in the bone cyst or ostitis fibrosa.

Why do I discuss the absence of ossifying periostitis in all central bone lesions? Simply to emphasize the contrast with the other types of sarcoma—the periosteal, in which more or less bone formation may be present both in the periosteal growth and in the area of involved shaft.

Types of Periosteal Sarcoma

I have gone over the histories, the x-rays, the gross specimens and microscopic sections of some 240 cases of sarcoma of the periosteal group, and have made, for working purposes the following classification:

(A) Ossifying Type (excessive periosteal bone formation).

(A-1) The shaft beneath the bone formation appears normal.

(A-2) The shaft beneath shows some osteoporosis or destruction.

The number of cases in A-2 predominates, and as a rule the diagnosis of sarcoma can be made from the x-ray only. But sometimes chronic osteomyelitis, syphilis, traumatic periostitis, myositis and exostosis cannot be differentiated from this type of ossifying sarcoma.

In the Journal of Radiology for March, 1920, almost three years ago, I had only one example of the type A-1, the excessively ossifying periosteal sarcoma with an apparently normal shaft. This case is there illustrated in Figure 70 (Pathol. No. 23284) and is reproduced in this article in Figures 7 and 8. This paper now being written is to report and discuss further examples of the A-1 type—excessive bone formation.

(B) Sclerosing Type. This form has just been discussed and appears with illustrations in the Journal of Radiology for February, 1923.

In looking at the x-rays, gross specimens and microscopic sections of the sclerosing type of periosteal sarcoma we may recognize three forms, based upon bone formation in the periosteal growth:

(B-1) Little or no periosteal bone formation illustrated by the case reported in the Journal of Radiology for February, 1923; and for March, 1920 (Figs. 65 and 66, Pathol. No. 25761).

(B-2) In this group there is considerable bone formation in the periosteal tumor, illustrated in Figs. 62, 63 and 64 in the Journal of Radiology for March, 1920 (Pathol. No. 15557).

(B-3) Periosteal bone formation about the sclerosing sarcoma of the shaft is excessive. This type is rare and often hard to distinguish from A-2.

(C) Osteoporosis. Destructive Type.

In this group the x-ray of the shaft and the study of the gross specimen show bone destruction. In the early stages it may resemble osteoporosis due to lipomasia of non-use[2]. In the sarcoma of the osteoporosis type only one bone is involved, while in the osteoporosis from fixation and non-use all the bones in the neighborhood of the joint show definite changes. This is the distinguishing feature between the benign and the malignant. I have now in preparation a paper describing this group.

The osteoporosis type of periosteal sarcoma may be subdivided into four groups, based upon the presence or absence of ossification of the periosteal tumor and the presence or absence of definite bone defects in the shaft.

Syphilitic periostitis with shaft involvement and infectious ossifying periostitis may have an x-ray picture very similar to this form of periosteal sarcoma[3].

(D) In this type of periosteal sarcoma there is a definite palpable peri-

Fig. 3-a Pathol. No. 30616. Case 1. Periosteal sarcoma, ossifying type. Photograph of longitudinal section through upper end of femur and tumor after amputation at hip joint. There have been two exploratory operations with partial excision. It is evident that the periosteal growth has increased in size since the x-ray September 5, 1922 (see Fig. 2). The gross picture is that of sarcoma and the marrow is involved with tumor.

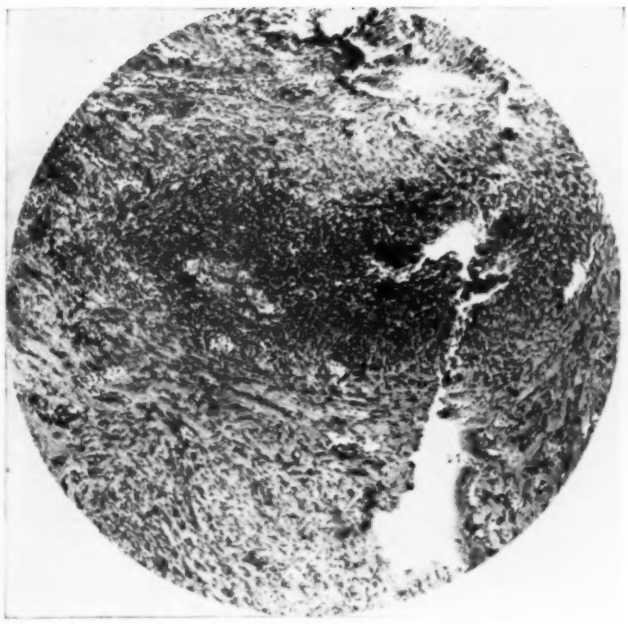

Fig. 4—Pathol. No. 30616. Case 1. Periosteal sarcoma, ossifying type. Microphotograph, low power, of infiltrated muscle outside of periosteal growth. For gross see Figure 3, for x-rays see Figures 1 and 2.

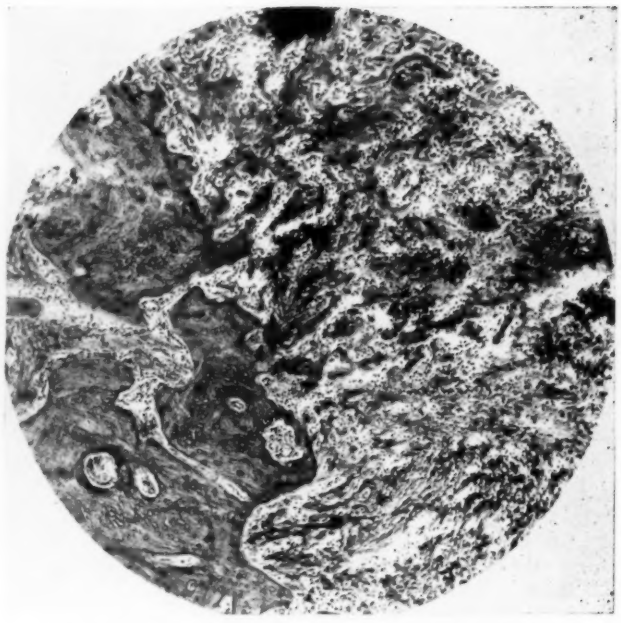

Fig. 4-a—Pathol. No. 30616. Case 1. Peritoneal sarcoma ossifying type. Microphotograph, low power, showing new bone formation to the left and sarcoma infiltrating muscle to the right.

osteal tumor, but the x-ray shows no bone formation. In some instances the shaft beneath the periosteal growth is normal and the differentiation from a sarcoma of the soft parts is impossible. In a few cases there are multiple marrow shadows due to tumor tissue, but no evident destruction of the cortical bone[1]. In other cases there is superficial destruction of the cortical layer of the shaft. The illustrations in the Journal of Radiology for March, 1920, picturing the different types of periosteal sarcoma should be compared with those in the number for August, 1922, of infectious ossifying periostitis.

This group D will be further discussed in another article.

I am not at all sure that this classification will ultimately be accepted, but up to the present time in a restudy of some 240 cases of periosteal sarcoma, the majority of the cases from a study of the x-ray and the gross specimen, can be easily placed in one of these four groups.

There seems to be evidence that a periosteal sarcoma may show definite changes as the period of the disease increases in length and the variations are in the ossification of the periosteal tumor and in the sclerosing or destruction of the shaft. So that one case may change from one group to another.

The object, however, of this classification is an attempt to ascertain, if possible, some more accurate method of differentiating the benign from the malignant in the early stage of the disease. The longer periosteal sarcoma is present the less difficult, as a rule, the diagnosis.

CASES 1 TO 8

CASE 1—(Pathol. No. 30616)—Periosteal sarcoma, ossifying type of shaft of femur below trochanters. (Figs. 1 and 2, x-rays; Fig. 3, gross specimen; Fig. 4, microscopic).

W. B. L., white male, aged 20, was referred to me by Dr. Frank D. Dickson and Dr. W. W. Duke of Kansas City, Mo., in June, 1922. I examined the x-ray pictures and the patient in Chicago.

In brief, the x-ray pictures resembled periosteal sarcoma of the ossifying type more than the benign ossifying periostitis, but the lesion palpated like bone. Up to that time I had never observed an ossifying periosteal sarcoma which palpated like an exostosis or a benign growth of periosteal bone. In all the previous cases of periosteal ossifying sarcoma the palpable tumor was larger than the ossifying tumor in the x-ray, and I could palpate a soft-part tumor on top of the bone formation.

I now know that the excessive ossifying periosteal sarcoma may, in rare instances, palpate like the benign exostosis or ossifying periostitis.

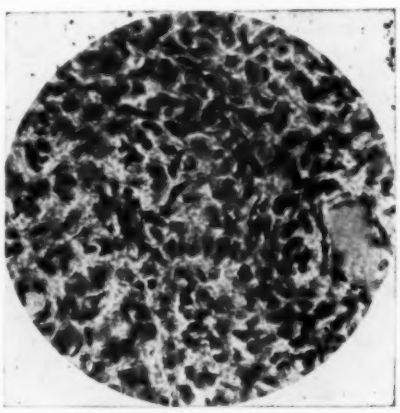

Fig. 5—Pathol. No. 30616. Case 1.—Periosteal sarcoma ossifying type. Microphotograph. High power. Tissue outside of bone filled with typical sarcoma cells, osteogenic type.

In this patient, aged 20 years, there had been intermittent pain, shooting up and down the right thigh for two years, and the palpable mass of bone for two years. In addition, there had been a dull ache in the tumor area. There had been a slight loss of weight. Every other examination was negative, and up to the time of the operation every other examination had continued negative.

The duration of pain and the palpable bony growth of two years without evidence of metastasis to the lungs and without evidence of bone destruction of the shaft and with no very marked increase in the growth of the periosteal bone, favored a benign lesion.

In the Journal of Radiology for March, 1920, when I reported 70 cases of periosteal sarcoma, it was noted that only six patients lived two or more years without evidence of metastasis.

X-rays in Case 1: Figures 1 and 2 are x-rays of the upper third of the right femur taken June 9, 1922. The most marked feature is an ossifying periosteal tumor below the intertrochanteric line, larger on the outer side. The new growth of bone seems to surround the shaft in spite of which, however, we can see shining through the almost normal marrow shadow and what appears to be an almost unbroken cortical

shadow. The evidence suggestive of sarcoma is that the new growth of bone encircles the shaft and the little isolated islands of bone a few millimeters distant from the outside, the main, shadow of the bone.

I have gone over the x-ray pictures of about 100 cases of benign exostoses and different types of benign ossifying periostitis. With the rarest exceptions does the new growth of bone encircle the shaft. The little isolated areas of bone formation may be present in the benign lesions.

Advice given in this case: I wrote that the x-ray suggested sarcoma, but the mass of bone palpated like a benign lesion. Up to the present time we have never cured a sarcoma by amputation situated above the middle third of the femur. Resection with bone transplantation of the fibula would be possible in this case. Dr. McClure, surgeon to the Ford Hospital in Detroit performed this some months ago with a very good functional result.

I therefore advised intensive x-ray treatment, which was given by Dr. Skinner of Kansas City.

X-ray Diagnosis by Dr. Phemister of Chicago: I showed these x-rays to Dr. Phemister in November, 1922. He expressed the opinion that it was a periosteal ossifying sarcoma. This opinion was based on the spindle-shaped enlargement of the ossifying area, the radiating area of bony tuberculae about the periphery, the apparent invasion of the marrow canal.

Fig. 6—Pathol. No. 29638. Case 3. Benign ossifying tumor of neck of femur. Tumor palpates like bone. No operation.

X-ray Treatment: This had no apparent effect on the size of the palpable mass, nor did the x-ray show any changes. The pain increased so that it was necessary to give the patient morphine. X-rays of the chest were negative for metastasis. The x-rays of other bones were negative. All other examinations were negative.

First Exploratory Operation: Dr. Dickson, November, 1922, five months after the first examination and two years and five months after the onset. The indication for the operation was the intense pain, and no definite improvement in the x-ray picture. At the exploratory incision. Dr. Dickson wrote there was no infiltration of the soft parts; the mass of bone was hard and well defined, too hard to remove with the cautery, so that a piece of bone was removed with the chisel and mallet; no soft bone was found.

Gross and Microscopic Study of First Piece Removed: The specimen consisted of firm bone resembling the involucrum of osteomyelitis. Sections of this showed new bone formation with no evidence of sarcoma. Dr. Phemister saw these sections and was unable to find any histological picture of sarcoma.

Second Exploratory Operation: Dr. Dickson, December, 1922. This was indicated because the patient continued to have more pain, requiring morphine for relief. At this operation posteriorly definite infiltration of the muscle was found.

At this second operation the tumor mass was exposed posteriorly, and it appeared more extensive than the x-ray would indicate. The posterior portion of bone was less dense than the anterior and came off in flake-like masses; there seemed to be infiltration of the muscle beyond. Portions of bone and soft parts were removed.

Fig. 7—Pathol. No. 23284. Case 4. Excessively ossifying periosteal sarcoma in old myositis. At X is the shadow of the old tumor of twenty years' duration.

Fig. 8—Pathol. No. 23284. Case 4.—Excessively ossifying periosteal sarcoma; possibly sarcoma in old ossifying myositis.

Fig. 9—Pathol. No. 32020. Case 5.—Benign excessively ossifying periostitis, or ossifying myositis. Stump six years after amputation.

It is important to note that at both operations, after removing bone, the exposed tissues were burnt with the electric cautery.

Gross Pathology: Figure 3 shows the particles of bone received. Attached to the piece of bone marked "4" is a bit of muscle.

Frozen Sections: (Fig. 4). In the muscle outside the bone a definite picture of sarcoma was found. The chief type of cell was spindle, and there was a great deal of eosin-staining intercellular substance. It resembled, therefore, sclerosing sarcoma. In other places we could see new bone formation without osteoblasts, indicating that the tumor cells were forming bone.

Hip-joint amputation was advised. This has been done. The patient is doing well. The gross specimen has not yet been received.

Pathological Fracture: Dr. Dickson wrote December 30, 1922, that after the second exploratory operation, at which he removed considerable bone, he left a bridge of bone anteriorly. This fractured, and as the boy was having considerable pain, he performed a hip-joint amputation December 29th.

He also wrote that at the second exploratory operation and at the examination of the specimen after amputation there was no evidence of extension of the process.

Fig. 10—Pathol. No. 32020. Case 5. Benign excessively ossifying periostitis or myositis. Longitudinal section through amputated stump. Note the normal marrow in shaft surrounded by a new growth of bone. At X an island of bone in muscle; at Y an osteophyte growing into muscle.

Remarks on Case 1: All of us, except Dr. Phemister, who was quite positive from the x-ray that it was sarcoma, were rather inclined to the view that it might be a benign ossifying tumor. This was based more upon palpation than upon the x-ray picture alone.

It is natural to ask the question whether in the benign ossifying lesion there could be as much pain as in this case. The pain increased. There is no evidence that the x-ray treatment increased the pain; it did not relieve it. I am rather inclined to the view that when we study our benign ossifying lesions of bone we will find that, in some of these, pain of this type may be present, and I will report a case of this kind here. (Case 5—Pathol. No. 32020).

CASE 2—(Pathol. No. 32122)—Excessive ossifying periosteal sarcoma of upper end of tibia; metastasis to lungs with ossification of the metastatic tumor in the lung. This case was reported by Dr. E. R. Le Count, Professor of Pathology of Rush Medical College.

This contribution of Le Count on pleural and pulmonary secondary osteosarcomas covers the literature from the contribution of Virchow in 1864 to 1909. In addition to reporting an example of this excessively ossifying periosteal sarcoma, he conclusively proves that the metastatic tumor from bone sarcoma may show ossification.

Dr. Phemister of Chicago has interested himself in the types of bone formation in sarcoma of bone, and he is inclined to the opinion and seems to have proved it, that sarcoma cells may produce new bone in both the primary and metastatic tumor, and he seems to have had a larger experience than any of us in this type of excessive ossifying periosteal sarcoma. I trust he will publish the results of his studies.

CASE 3—(Pathol. No. 29638)—*Benign ossifying periosteal tumor of the neck of the femur.* (Fig. 6).

Figure 6 is an x-ray sent me by Dr. John A. Talbott of Washington, D. C., February 14, 1922. Both of us were inclined to the opinion that the lesion was benign and probably of the exostosis type. Operation was advised against. The patient was a colored male aged 30 years, an ex-soldier. His occupation before the war was that of a plasterer. While in the army several years ago he received a severe blow with a trench shovel in the region of the involved bone. There was pain and disability for a few days. Then an interval of freedom; then recurrence of pain with slight stiffness. The x-ray is shown in Figure 6. The examination showed some limitation of rotation and abduction and slight flexion. A bone-like mass could be palpated posterior and medial to the great trochanter, and there was a visible tumor in the gluteal region on the left side. Other examinations were negative. A stereoscopic plate showed that the bony growth did not encircle the neck. The man's disability was slight. It is now one year since this x-ray was taken and no change has been observed.

In the x-ray one observes that the outline of the new growth of bone is sharp and there are no shadows of islands of bone outside the main tumor, and no evidence of bone destruction

Fig. 11—Pathol. No. 15283. Case 6. Benign excessive ossifying periostitis or myositis in stump after amputation of femur for osteomyelitis. This bone formation has since disappeared.
Fig. 11a—Pathol. No. 15283. Case 6. X-ray of stump six years later showing ossifying myositis has disappeared.

can be seen in the neck of the femur.

CASE 4—(Pathol. No. 23284)—Excessively ossifying periosteal sarcoma; possibly sarcoma in old ossifying myositis. Death, with symptoms of metastasis to lungs. Operation and autopsy refused. (Figs. 7 and 8).

This case has previously been reported in the Journal of Radiology for March, 1920 (Fig. 70). At that time it was my only example of the periosteal sarcoma with excessive bone formation.

Clinicol Note: I saw this patient in June, 1918. She was referred to me by Dr. Edward P. Shelby of New York. The patient was a white female, aged 38 years, who had increasing pain and tumor around the lower shaft of the femur of two years duration following a trauma. When we went into the history more carefully, we ascertained that she had been a continuous horse-back rider from youth, and twenty-four years ago, at the age of 14 she had observed a painless hard mass in the adductors above the internal condyle of the right knee. This mass remained quiescent twenty-two years; no x-ray had been taken. Then, two years ago, there was the trauma with increasing pain and a gradual development of a larger bony mass surrounding the lower third of the femur.

The lateral x-ray (Fig. 7) shows a light, round shadow at "X" which suggests an old myositis of the rider's bone type. But now, surrounding the lower shaft of the femur there is an excessive growth of new bone, most marked posteriorly, and when we study the shadow of this new bone formation in the lateral view (Fig. 7) and in the antero-posterior view (Fig. 8) we find no positive evidence of destruction of the shaft, and the bone formation on the shaft in the inner zone is that of a benign ossifying growth. But the periphery has fine spicules of bone extending into the soft parts, which is suggestive of sarcoma.

However, this picture may be seen in ossifying myositis.

Figure 7 was taken in November, 1917, and Figure 8 in June, 1918. If pictures were taken after these dates, I was not informed.

A number of surgeons and roentgenologists saw these x-rays, and all of them considered the possibility of an old ossifying myositis, as well as the question of a secondary sarcoma. In 1918 the x-ray of the chest was negative. The patient refused amputation, and at that time I advised against an exploratory incision, as I could not conceive of its value if the patient refused the indicated amputation, should the section show sarcoma.

The patient continued to suffer pain and then began to lose strength and flesh. She died in May, 1920, with symptoms of metastasis to the lungs.

Remarks on Case 4: It is difficult to explain the death of this patient except on the diagnosis of a sarcoma with metastasis to the lung. It still represents the largest ossifying periosteal tumor in my group of 240 cases.

CASE 5—(Pathol. No. 32020)—Benign excessively ossifying periostitis or myositis about the femur in an amputated stump six years after amputation. Patient of Dr. Wm. S. Baer of Baltimore.

Figure 9 is the x-ray of the amputated stump. This new bone formation could be palpated directly beneath the skin, at the end of the stump and everywhere the bony tumor could be palpated without any evidence of infiltration of the soft parts. Figure 10 is a photograph of a longtitudinal section through the femur and bony growth. The femur is practically uninvolved; the marrow tissue is normal; the bony growth can be separated from the shaft of the femur, and the bone beneath is smooth, but there is no periosteum. The growth of bone is, therefore, outside the periosteum and infiltrates the muscle. In the rectus muscle, at "X" there is an isolated piece of bone.

Careful microscopic study of numerous sections shows no evidence of sarcoma; numerous osteoblasts are present about the bone lamellae. Between the bone there is inflammatory tissue. The patient is in good general health without evidence of metastasis to the lungs.

Clinical Note: Six years and seven months ago this adult woman was operated on by Dr. Baer at the Union Protestant Hospital, and the thigh was amputated in the middle third. At that time, in 1916,, pieces of bone were sent to the laboratory, and are recorded under Pathol. No. 19358. The gross and microscopic study at that time recorded the diagnosis of a benign osteoma, apparently growing from the lower end of the femur. I have restudied both the gross specimen and the sections and can find no evidence of sarcoma. When the bone pieces are placed together we get the impression of a pedunculated tumor, and in the sections we find cartilage on top of cancellous bone. This is a picture only found in the benign exostosis. Up to the present time we have not yet received from Dr. Baer a complete history of the orignal lesion.

Ultimate Result: A number of letters from the patient to Dr. Baer are filed with the pathological report. Apparently she suffered from a painful stump, and was unable to wear her artificial leg very much. A letter dated 1917 still complained of a painful stump and inability to wear the artificial limb. In June, 1922, about six months before her readmission, she informed us that she was free from pain from February, 1920, to February, 1921, and then the pain returned.

Clinical Note on Readmission in January, 1923: The patient is now 46 years of age. Some sixteen years ago, ten years before the amputation, her knee was injured by a polo ball.

Fig. 12—Pathol. No. 27702. Case 7. Benign osteofibroma, periosteal, in upper end of fibula. Operation—resection. See Figure 13 for result.

Fig. 13—Pathol. No. 27702. Case 7. Excessive bone formation after resection of the fibula for primary lesion shown in Figure 12. X-ray one year and four months after operation.

About one year before her admission to Union Protestant Hospital, in 1916, the knee became swollen and stiff. Apparently the first operation at the hospital was the removal of the bony tumor, which I have described, and then ten days later, the amputation. The exact duration of the palpable bony mass in the stump is not given in the history.

Remarks on Case 5: The long interval between the first amputation and the second is evidence against malignant disease. Nevertheless, the bone formation in the stump is unusual and very excessive. As a rule ossifying myositis follows immediately after the trauma, reaches its height and then gradually recedes. I have only one example of an ossification in a stump similar to this (See Case 6). Here the bone formation was immediate and then receded and has now almost disappeared.

CASE 6—(Pathol. No. 15283)—Benign excessive ossification in end of stump after amputation of femur for osteomyelitis. The x-ray (Fig. 11), shows a very large amount of bone formation in the stump beneath the end of the femur, and the two silver plates used in the previous operation after the fixation of a fracture. The amputation was performed because of infection and osteomyelitis.

Clinical Note: This adult male came under my observation some ten years ago. There was a fracture of the shaft of the femur below the trochanter with overriding and non-union. The operation for reduction and plating was a very difficult one, due to excessive callus. There was first a low-grade infection of the soft-part wound, then a secondary osteomyelitis, then a general septicemia. The amputation was rapidly performed to prevent death from general infection. This bone formation took place within six weeks in a wound healing by granulation. Nothing was done, except removal of the plates. Within the two years most of the bone formation has disappeared (Fig. 11-A), and the patient has been able to wear an artificial leg with comfort.

CASE 7—(Pathol. No. 27702)—Benign (?) excessive bone formation after resection of the upper third of the fibula for a benign periosteal ossifying growth. Figure 12 is an x-ray of tumor of fibula before resection. Figure 13, one year and four months after resection, shows ossification, and Figures 14 and 15 show excessive ossification of the upper half of the leg three years after operation.

Clinical Note: This was a white female, aged 22 years, a patient of Dr. R. G. Le Conte of Philadelphia. There has been no history of trauma, but there had been observed in the region of the upper end of the fibula a painless bony growth for some years. The tumor palpated like bone, similar to Case 1 in this paper. The x-ray (Fig. 12) shows a growth of bone surrounding the upper third and the head of the fibula. The shaft of the fibula, apparently unchanged, is seen shining through the surrounding bony growth. The outlines of the ossifying periosteal tumor are very distinct and islands of bone outside the tumor area observed in Case 1 (Figs. 1 and 2) are not seen in this case. The clinical picture, the palpation and the x-ray all indicate a benign periosteal ossifying lesion.

Operation, November, 1919, Dr. Le Conte: Dr. Le Conte informs me that in removing the tumor he cut through muscle beyond the tumor and sawed the fibula below the tumor. The external nerve was dissected out of a groove, but he did not think he exposed tumor tissue. The tumor rested upon the tibia like a saddle, and in this part of the operation the tumor had to be broken off the tibia, but there was no evidence of bony connection and perhaps in doing this the periosteum of the tibia was stripped.

Microscopic Study: The tumor is an osteofibroma, that is, between the islands of bone there is fibrous tissue with no cellular areas suggesting sarcoma; nor was I able to find any evidence of myxoma or chondroma. The muscle outside of the tumor shows myositis. Although in the x-ray the tumor appears to be chiefly bone, in the gross and in the sections it is largely fibroma.

X-ray Result: March, 1921, one year and four months after operation (Fig. 13). We observe that in the defect after removal of the upper end of the fibula there is the shadow of a new growth of bone; it extends down the shaft of the upper end of the remaining portion of the fibula and overlaps the upper third of the tibia. This area palpates like bone. There is no tenderness.

At this time Dr. Le Conte and Dr. Lee discussed the possibilities. We were all rather inclined to the view that it was a benign growth of bone due to the ossification of a postoperative hematoma, or to the stripping of the periosteum of the tibia, and further operation was decided against. Apparently there is no doubt that the traumatic ossi-

Fig. 14—Pathol. No. 27702. Case 7. X-ray. 1/12/1923. Benign (?) excessive bone formation three years after resection of the upper end of the fibula for tumor shown in Figure 12.

Fig. 15—Pathol. No. 27702. Case 7. X-ray, 1/12/1923. Benign (?) excessive bone formation three years after resection of the upper end of the fibula for tumor shown in Figure 12.

fying periostitis and ossifying myositis are better left alone.

The entire object of this paper is an attempt to differentiate these benign ossifying lesions from the ossifying sarcoma.

X-ray October 11, 1922: The interval is now almost three years since the resection and almost two years since the last x-ray. On palpation there is a growth of bone extending from the knee-joint to the junction of the middle and lower third of the leg. The bone surrounds the shafts of the fibula and tibia.

X-ray January 12, 1923: These x-rays are reproduced (Figs. 14 and 15). The increase in bone formation since October is very slight. In the lateral and antero-posterior views the bone formation more resembles ossifying myositis than any well known ossifying lesion, but this should be compared with the x-ray in Case 4 (Figs. 7 and 8), which has been diagnosed ossifying sarcoma, because the patient died of metastasis.

This patient in Case 7 is in perfect health, the x-rays of the chest show no metastasis; she is suffering no pain. It is important to note that in Case 1 and in Case 4, both sarcomas, pain was a prominent symptom, and in Case 5 the excessive ossification of an amputation stump, pain was also a prominent symptom. In Dr. Le Conte's patient there is no difficulty in walking, but flexion in the knee-joint is somewhat restricted.

Remarks on Case 7: Were it not for the evidence of sarcoma in the ossifying growth in Case 1 and the probable

Fig. 16—Pathol. No. 800. Case 8. Benign osteoma, or ossifying myositis of upper end of humerus. Photograph of patient before operation in 1894.

sarcoma in Case 4, I would be inclined to the view that in this case of Dr. Le Conte the ossifying growth is benign. The microscopic evidence in Case 5, Dr. Baer's case, excessive ossification of the stump, indicates that it is benign.

From my study of the situation up to date it seems to me that the only treatment in Le Conte's case is what Dr. Baer used in his—amputation. In Dr. Baer's patient the excessive bone formation was only apparent many years after amputation, in Le Conte's case it was gradual since November, 1919, three years ago. We have, therefore, no evidence that this excessive bone formation will cease, and we must also bear in mind the possibility of sarcoma. In Baer's case the stump was useless for an artificial limb, in Dr. Le Conte's patient, if bone formation continues, there will be greater loss of function at the knee-joint.

Cases of this kind show the importance of a restudy of the possibilities of excessive bone formation, both benign and malignant. I have gone over all the cases of exostoses or benign ossifying tumors subjected to operation, and, although in some there has been reformation of bone, in none has it been as excessive as in Le Conte's case; it usually appeared directly after operation and then gradually receded.

In the restudy of the cases of ossifying myositis the same is true—rapid formation of bone after trauma and then, after a short time, recession.

These two stumps, Baer's and mine, are the only two showing excessive bone formation. In mine it appeared immediately and then receded, in Baer's case it appeared late and was progressive.

CASE 8—(Pathol. No. 800)—Benign osteoma or ossifying myositis surrounding the upper third of the humerus. Diagnosed in 1894 ossifying sarcoma. Amputation at the shoulder-joint. Death eight years later with symptoms of obstruction of the esophagus (Figs. 16, 17, 18 and 19).

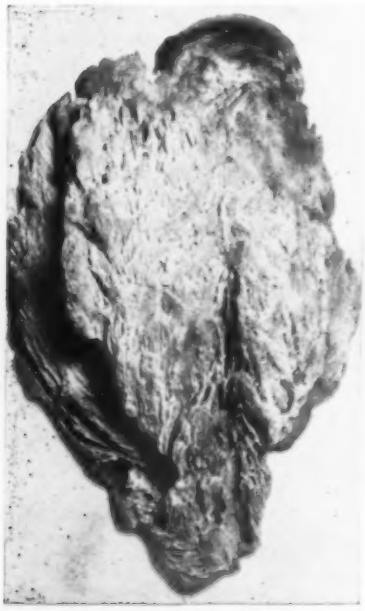

Fig. 17—Pathol. No. 800. Case 8. Benign osteoma or ossifying myositis of upper third of humerus. Photograph of surface of dried specimen.

Fig. 18—Pathol. No. 800. Case 8. Benign osteoma or ossifying myositis of upper third of humerus. Photograph of longitudinal section through shaft of humerus and surrounding bone tumor and infiltrated muscle.

Fig. 19—Pathol. No. 800. Case 8. Benign osteoma or ossifying myositis of upper third of humerus. X-ray of specimen shown in Figure 17.

Clinical Note: This patient was referred to Johns Hopkins Hospital by Dr. Reed White of Lexington, Va., in 1894. He was a white male, aged 30, a farmer. Some eighteen months before there had been a trauma followed by pain and a gradual swelling of the upper third of the arm. The uniform, irregular swelling is shown in Figure 16. My note made at that time reads as follows: Uniform swelling; tumor, hard like bone; surface, irregular; some restriction of motion at the shoulder-joint. Dr. Halsted then was of the opinion that it was an ossifying sarcoma and asked me to perform the amputation. The gross specimen and sections are still preserved in the laboratory, now 29 years since the operation, and old and new sections have been repeatedly studied without finding any areas of sarcoma. The surface of the gross specimen with its irregular outgrowths of bone is shown in Figure 17; the longitudinal section in Figure 18. The marrow cavity of the humerus is normal; the inner cortical bone is normal; in the outer cortical bone there are cavities; the new growth of bone springs from the shaft and extends out into the muscle. The base is eburnated and the outer portion of the bone more porous. In both types of bone there are cavity formations which resemble the marrow cavity. The sections show new growth of bone, and in the larger cavities between the bones fatty tissue, in the smaller areas between bones fibrous tissue.

Remarks on Case 8: I have always looked on this case as an example of benign excessive ossification. Yet it is possible that the late death (eight years later) may have been due to metastasis to the lung with pressure on the esophagus. Dr. Phemister informs me that in one of his cases of ossifying sarcoma death from metastasis to the lung did not take place until seven years after amputation.

Figure 18 is an x-ray of the specimen.

Conclusions

This paper is but an introduction to this study. In subsequent papers I propose to report on ossifying myositis, the different types of ossifying periostitis and exostoses with an attempt to get at evidence of how we can recognize the excessive ossifying sarcoma.

These cases and this subject have just been presented to the Eastern Section of the American Roentgen Ray Society at their meeting in Atlantic City, January 26, 1923.

The discussion demonstrated that the ossifying type of periosteal sarcoma resembling Case 1 is a rare occurrence. That excessive ossification of the stump as in Baer's Case 5 and in mine, Case 6, is almost unique.

Also the excessive ossification after resection of the end of fibula, Case 7, patient of Le Conte, has apparently never been observed before. Dr. David B. Bowen of Philadelphia who took and studied the x-rays in Le Conte's case, was rather inclined to the diagnosis of malignancy and to immediate amputation.

A second paper will be published on this group, in which will be included the observations of bone formation after x-ray treatment of periosteal sarcoma.

The entire problem of bone formation associated with benign and malignant lesions of bone demands further investigation.

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Relative Value of X-Ray Evidence in the Diagnosis of Duodenal Ulcer

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NOT many years ago ulcer of the duodenum was thought to be a rather rare condition, far overshadowed in importance by gastric ulcer. Final recognition of the fact that the contrary is the case was brought about very largely by the efforts of the roentgenologist. From the first broad clinical study of this condition, therefore, the evidence obtained from the roentgen ray examination was accorded first place in its diagnosis. However, since it is always rather dangerous to become too well satisfied with one's own conclusions, and since the specialist has always been subject to adverse criticism on the ground of his restricted viewpoint, it has seemed worth while to analyze a small series of duodenal ulcer cases which have been studied not only by x-rays methods, but with regard to the chemistry of the gastric contents, the history and the physical findings. In these cases the various investigations mentioned were made all at the same time and by the same organization. The patients have been carefully followed up and are still nearly all under supervision. It should be pointed out that there has been no surgical confirmation of the diagnosis in any of them for the reason that they were all uncomplicated cases of the type which yield rather readily to medical measures. It may perhaps be considered that the uniformly prompt and decided response to dietary and alkaline therapy has in itself constituted a confirmation of the diagnosis.

Routinely, an exhaustive history has been taken and a physical examination made on the day before the laboratory phases of the investigation were begun. If, then, either of these preliminary measures cast suspicion upon the gastro-intestinal tract subsequent work was started by fractional analysis of the gastric contents, followed by x-ray examination of the entire gastro-intestinal tract including the gall bladder. Complete routine blood examinations including the Wassermann test, and complete urine examination, were, of course, made in all cases. If, following these investigations, the diagnostic picture was still incomplete, further work was done in following up any special angles which may have suggested themselves.

For this analysis only forty cases were used. This number of recent clear-cut duodenal ulcer cases still under observation, and with complete records embodying the features outlined, was available, and it was thought preferable to make a close study of a comparatively small number rather than to include a larger mass of material which was in some particular incomplete or obscure.

The typical ulcer history is often considered in itself almost sufficient evidence for a diagnosis. It is interesting to note that such a history including recurring attacks of digestive disturbance, characterized by hunger pain coming on from two to three hours after food, and relieved by swallowing food or alkalies, was obtained in only 45 per cent of these cases. In 20 per cent, very careful questioning, often repeated in the form of leading questions after the examination, failed to uncover any historical evidence at all suggestive of ulcer. In two of the pa-

*—Read at the Annual Meeting of the Radiological Society of North America at Detroit, Dec. 6, 1922

tients, sudden and severe hemorrhage had been the only symptom prior to examination. Thirty-five per cent were not typical in history, but were suggestive, in that the history mentioned a more or less prolonged period of atypical dyspepsia. On the other hand, we have not infrequently had quite conclusive ulcer histories from patients, who on close examination, failed to show anything more than hyperchlorhydria.

Physical examination is not expected to give a great deal of information with regard to duodenal ulcer unaccompanied by obstruction or malignant change. Epigastric tenderness and rigidity or muscle guarding are the only objective signs we have found in any considerable proportion of these cases, and they are, of course, not at all peculiar to this condition. Both were entirely absent in 30 per cent of the cases studied. A point of tenderness overlying the shadow of the duodenum, when palpation was guided by fluoroscopy, was found present in about the same percentage of cases as epigastric tenderness during the original physical examination.

Analysis of gastric contents was done routinely by the fractional method. The small Rehfuss or Lyon's tube was given the patient to swallow before food was taken in the morning. The gastric residuum was recovered and the usual Ewald test meal given without removing the tube. Specimens were then withdrawn every fifteen minutes until the stomach was empty or until two and one-half hours had elapsed. These specimens were titrated for free and combined acid and the usual graphic curve constructed. Each specimen was also tested for occult blood. As pointed out by Crane before this society last year, the two types of acid curve most typical of ulcer are the one which starts high and remains high throughout the digestive period, and the one which, while starting out at a normal point or a low point, constantly ascends, remaining at or near its high level when the stomach is empty. We found one of these two types in 37½ per cent of these cases—however, the remainder show either an acid curve which was in all respects normal and was going down rapidly at the end of the digestive period, or even a sub-acid curve with all the figures below normal. This latter condition was obtained in 25 per cent. We did not encounter achylia in this series, although a few cases showed complete anacidity at the end of the first hour and would have been listed as cases of achylia under the one hour Ewald meal technique. There was one feature consistently present in all these analyses—namely, the clean character of digestion, there being uniformly a minimum of gastric mucus, and complete absence of pus.

As previously stated, all gastric fractions were tested for occult blood and the feces were likewise so tested. We found occult blood in one or more fractions in only 20 per cent of the cases here reported. Blood was found in the stool after the omission of meat from the diet in only five cases. In a number of patients the tube was allowed to pass into the duodenum for the gall-bladder drainage procedure described by Lyons and others. While we recovered microscopic or chemical blood with the duodenal return in many of these cases, it was so inconstant a finding that we attach no significance to it if absent. As an independent test, we do not feel that it would be worth doing for any information it might afford in regard to the presence or absence of ulcer in the duodenum. We have not used the silk cord test to investigate the presence or absence of bleeding in the duodenum.

From the roentgen standpoint 80 per cent of the cases gave direct evidence of duodenal ulcer in the presence of the typical persistent cap deformity of the type recognized as being associated with this condition. In the remainder the evidence was indirect and consisted of failure to fill a normal cap in spite of postural and palpatory efforts as well as hypertonus, hyperperistalsis and hypermotility. In no case have we been able to make a diagnosis of duodenal ulcer without one of these two sorts of x-ray evidence. All patients not showing a definitiely normal gastro-intestinal tract on the first x-ray examination were re-examined after atropin or belladona had been given to physiologic effect. This re-examination has frequently sufficed to rule out cases which from our initial observation would have been considered distinctly pathological. It is a somewhat time consuming precaution, but has saved us not a few embarrassing mistakes.

Briefly, we have found direct x-ray evidence of duodenal ulcer in 80 per cent; indirect x-ray evidenc in 20 per cent. Of the objective evidence, all of that obtained from the laboratory and from the physical examination was so inconstant and uncertain that it is felt to be of value only if positive. The history, when typical, has always been thought to be of the very greatest value, and certainly it seems to us to rank second in importance and in reliability only to the roentgen examination. The present small series, however, would seem to substantiate the view that it, too, has value only if positive, and even then may be misleading. Particularly have we been disappointed in the results from fractional gastric analysis.

This proceeding, which had previously been occasionally used in our laboratory, we adopted as a routine in all ulcer suspects about a year ago. The suppositions upon which it is based seemed so reasonable and the technique so adapted to permit accurate following of the digestive process, that we hoped to obtain, as others believed they had, consistent findings which would offer material aid in diagnosis and in guiding treatment. The finding that many of the acid curves so constructed seemed to adhere closely to previously described types, and were often in accord with the evidence obtained from other sources, supported us in this hope. The fact, however, that only about one-third of this series of cases gave at all typical ulcer curves, while the remainder were either normal or subacid, coupled with the not infrequent finding of high or rising acid curves in conditions which were obviously not ulcer, as for instance chronic appendix, and gall-bladder cases, has left us without much confidence in the evidence to be obtained by this method. Recent work seems to offer an adequate explanation of this unreliability, since it has apparently been proved that the gastric contents are not intimately mixed and homogenous except at the end of gastric digestion. Samples taken at intervals of seconds, through the same tube and from the same stomach have shown variations as wide as thirty points in the free acidity. Furthermore, there is probably no direct connection between gastric acidity and ulcer. It is well known that duodenal ulcer and complete achylia may occur together, and it is probable that when increased acidity does occur it depends rather upon obstruction from pylorospasm or from organic causes than upon any direct influence of the ulcer itself. As pylorospasm is by no means a constant condition in ulcer, neither may hyperacidity be expected to be.

There are rather obvious reasons why blood in the stomach contents or the stool should be an inconsistent and occasional finding. Massive hemorrhage occasioned by the erosion of a vessel is, of course, a positive and dramatic, but fortunately, rather rare symptom. The presence of minute quantities of blood must depend on trauma either from hyperperistalsis or from food, and must necessarily be of rather capricious occurrence. Further, the possibility of error from outside sources, as traumatism from the tube, in the case of gastric contents, and the introduction of blood from the lower gastro-intestinal tract in the case of stool specimens is too great to permit of reliance either in a positive or nega-

tive direction being placed on this finding.

The characteristic feature of the typical ulcer history is pain, occuring two or three hours after eating—in other words, at about the time the hyperactive stomach of the ulcer patient has emptied—and assuaged by food or by alkalies. It has been shown quite conclusively that this pain is not caused, as was formerly supposed, by hyperacidity, but rather by excessive peristalsis. Many clinical and physiological studies have proved that the pain and the peristalsis are synchronous, and that the acidity may be nil at the moment of the greatest pain. Hyperacidity, when present, may reflexly induce contraction and thus indirectly cause pain, but is neither the direct nor the only causative factor. On the other hand, when hyperistalsis is not caused by excess of acid it is undoubtedly due to reflex effects from the ulcer itself, and therefore should be expected to vary with the location of the ulcer as regards the nerve paths and with the extent of the zone of inflammation, and consequently hyperexcitable nerve endings, about it. These two variable and more or less accidental factors probably explain the frequency with which atypical histories are encountered.

On the other hand, there are obvious reasons why the x-ray evidence should be consistent and reliable. It is based upon two pathological changes which must of necessity accompany, in greater or less degree, all active ulcers, namely, the break in continuity of the mucus membrane itself, and the inflammatory zone, with its irritated nerve ending, surrounding it. The direct roentgen evidence, which is to say the cap deformity, depends in variable degree upon these two factors acting together, a part of the deformity, indeed sometimes practically all of it, being reflex in character. The known ability of very small ulcers to produce a massive and persistent deformity depends upon the accompanying inflammatory irritation of adjacent nerve paths. The subsidence of the inflammatory zone as healing progresses explains the lessening cap deformity in the face of the fact that the scar may be as large as the ulcer. When healing has finally occurred ,if the lesion has been deep enough to produce a scar of any size, an irregularity will persist, but it will be unaccompanied by any exaggeration from reflex sources. The failure of the surgeon, by external inspection or palpation of the duodenum, to find many ulcers diagnosed by the roentgenologist upon what was, to him, very conclusive evidence, is, of course, explained by the reflex character of the considerable deformity seen by the roentgenologist, the ulcer itself in these instances being small and shallow without induration of the base or scar formation. Indeed, it may be merely an erosion of the mucosa. General anesthesia will abolish such reflex spasm, while atropin, at least in ordinary dosage, will not do so. The so-called indirect roentgen evidence, including retention, hyperperistalsis, hypertonus, and hypermotility, is, of course, all reflex in character, except where the retention is based upon organic obstruction, but is again sufficiently direct character that it is not abolished by ordinary doses of atropin, as is the case with spasm from extrinsic causes.

In the future we shall probably be satisfied with the laboratory report from the one hour test meal, placing little emphasis upon the acid values, and considerable stress upon the presence of gastric mucus, blood, evidence of retention from the previous meal, etc., with possibly also a routine analysis of the fasting stomach contents. The importance of a careful and searching history, of course, must remain unquestioned, but failure to obtain historical evidence of ulcer will not act to cast doubt upon positive x-ray findings.

EDITORIAL

The JOURNAL OF RADIOLOGY

A Journal of ideas and ideals.

Published monthly at Omaha, Nebraska, by the Radiological Publishing Company for The Radiological Society of North America.

Subscriptions—In the United States, its possessions and Mexico, $5.00 yearly; Canada, $5.50; elsewhere, $6.50 the year.

Advertising rates on application. All advertising must conform to American Medical Association Rules.

Payments for subscriptions and advertising must be made to Radiological Publishing Co., in New York or Chicago Exchange.

Address all communications to Business Office, 305 Arthur Building, Omaha, Nebraska.

Radiology Today and Tomorrow

NO THINKING MAN can read Floyd W. Parsons' article in the Saturday Evening Post of March 10th under the heading, "Science and Everyday Life," without being impressed with the outstanding fact that radiant energy is becoming more and more recognized as the keystone of the arch of all science.

This means that radiology as such embraces a much greater field than the mere application of x-rays diagnostically and therapeutically. There are many other octaves in the spectrum which probably have as great, if not greater possibilities therapeutically. For instance, ultra violet in the past couple of years has come to be recognized as having a much wider range of application in the common everyday run of human ills than perhaps x-rays. And this statement is entirely devoid of any thought of repugnance to the enormous diagnostic and therapeutic value of x-rays.

But without particularizing with reference to the divisions and subdivisions of the science of radiology, medically and biologically, it is worth while noting the fact that there is a rapidly increasing recognition of the wide uses of radiant energy in the commercial field. One or two illustrations will suffice: chemical analysis, the discovery of spurious paintings, the grading of paper, differentiation between cotton, wool and silk in manufactured goods, and the disintegrating of water by radioactivity in the manufacture of ammonia.

Without indulging in quotations, the Journal desires now to call attention again to an editorial found therein in the February, 1922, issue, entitled "A Scientific Renaissance," for that editorial portrayed our belief in the future of the science of radiology—a belief which is becoming more vital to the conduct of this science as an integrated part of everyday life.

As has been previously stated, there are a great number of men in the world who are interested in the medical and biological application of this particular science. To perform a real service for these laborers in the medical profession is the object of the Journal. And since most of these men have no especial knowledge of physics or ultra-scientific characterizations, due to the fact that this science has been discovered and applied since their medical training was finished, it becomes necessary to develop the various phases discussed in language that is easily comprehensible.

By the same token, it will be recognized that if the Journal is to be "of the greatest service to the greatest number," it will have to carry a message for every man interested in the science, whether he holds himself out as a specialist or uses radiant energy in some form merely as an adjunct of his medical practice.

The science of radiology has become so important to the man in the street therapeutically, and perhaps biologically, that entire freedom from the machinations of cliques and partisan politics of the few or many, must be maintained at all hazards. Each issue of the Journal must be so builded that it will constitute a stepping stone to that greater application of the science it represents and espouses, which must be the ideal sought to be achieved by every honest devotee, whether he be a member of the medical profession or not. The man practising medicine in the isolated community who seeks to bring this science into his own practice for the benefit of his patients is in just as great, if not greater need of the assistance this publication can and should bring him, than is the man in the large centers who has access to the experience of other men in his particular field.

Finally, the opportunity for humanitarian service is much too great for any constricted and narrow interpretation of the science of radiology; and if the radiologists of today hope to merit the respect of the radiologists of tomorrow, nothing less than an entirely unselfish and far-visioned purpose can suffice.

Research

ALL SCIENTIFIC advance is made by painstaking research, research carefully planned and diligently executed. We have just celebrated the centenary of the great Pasteur to whom medicine of today owes its very existence. Although Pasteur himself was not a physician, his investigations in bacteriology proved the cause of various bacterial diseases. At the same time, he showed us the cause of putrefaction in various food-stuffs and thus was the father of modern methods of preserving fruit and vegetables, pasteurising milk and using refrigeration. The inspiration thus given has led to the stamping out of smallpox, diphtheria, typhoid fever, malaria and yellow fever.

When one of our leading surgeons first came to Omaha he spent many sleepless nights doing intubations and tracheotomies to save the lives of children dying of diphtheria. At that same time an acquaintance of ours buried seven children in one winter, all had died of diphtheria. He himself was compelled to dig the grave of the last one, so great was the fear of the epidemic. Is it any wonder they called it the "black plague"? Contrast this picture with the low mortality rate nowadays, since the general use of diphtheria antitoxin. And thank God that your children were born today instead of in the days before diphtheria antitoxin was known.

Typhoid fever was formerly one of the most common and one of the most deadly bacterial diseases. So recently as during the Spanish-American War, deaths from typhoid fever were many times more numerous among soldiers than deaths due to war wounds. In the recent World War, scarcely a soldier died of typhoid fever. There is scarcely a family grown to maturity but has one or more vacant chairs in the home, from death that was due to typhoid fever. Well do I remember a brother physician who was cut off at the zenith of his professional career by typhoid fever contracted from the polluted water supply of a city where he had attended a national medical meeting. The

research of Pasteur and his successors has made possible the prevention of such catastrophies as those just enumerated.

The French engineers realized the advantages and possibilities of building a canal through Panama but yellow fever killed the men more rapidly than new ones could be supplied to take their places. It remained for the Americans, Reed, Carroll, Lazear, Agramonte, Cook, and others, to offer themselves a living sacrifice to prove that the cause of yellow fever had been discovered. When this was definitely proved the methods of prevention were already at hand. Due to this fact, not only has the Panama Canal been built, but the country along its borders has in reality been made more healthful than the United States. The death rate in the Panama Canal Zone, according to the United States census of 1910, was 1.7 per cent, while in New York City, Philadelphia and Washington, D. C., the rates were 2 per cent, 2.1 per cent and 2.2 per cent, respectively.

The ability to conquer tropical diseases opens up wonderful possibilities for civilization and may mean that the greatest future development in civilization will be found in the tropics. Mr. Herbert J. Spinden, in the February number of the World's Work, has called attention to this trend of civilization. Would that Pasteur's spirit could hover over us now and see not only what has already been accomplished through his efforts in research but the possibilities for the future.

Turning more particularly to research in the field of radiology, let us look for a moment at the developments which have followed the work of Wilhelm Konrad Roentgen. We imagine that he little dreamed when he first discovered the rays that he had found a scientific truth which would upset the whole arrangement of chemical elements and at the same time would make possible the analysis of unknown chemical substances by so simple a procedure as making an x-ray spectrogram. We doubt whether he realized that he had laid the foundation for the discovery of radium or that he had set in motion work which would make it possible for one to speak around the world by radiophone. Yet in the twenty-seven years that he lived after his wonderful discovery, he saw these very things made possible. The x-ray was adopted almost immediately by the medical profession, but its use is not confined to medical purposes. It is used in the pearl industry, in the tobacco industry, in the chemical industry, in the steel industry, in the shoe industry, in law, in biology and probably in many other ways not mentioned.

To the painstaking effort of Roentgen and his followers, we owe all these advances. We should not pass without mention of the work of Mr. Clyde Snook, W. D. Coolidge, Ph.D.; William Duane, Ph.D., and Friedrich Dessauer, Ph.D. The works of these men stand as their memorial. All of them, save Roentgen, are still living and are still busily engaged in further research. Who can forecast what their future achievements may be? The accomplishments of these men illustrate the epigram said to have come from the lips of Dr. W. J. Mayo, "The first problem in research is to find the man."

The present trend in economic life is toward organization. This trend has also affected the medical profession. There is a desire on the part of the far seeing leaders in medicine to coordinate all effort. This same spirit affects the various branches of medicine and among them radiology. In a recent address, Sir Humphrey Rolleston, President of the Roentgen Society of Great Britain, pleaded for a unification of all radiologists of Great Britain. There are now two societies of radiologists in Great Britain but it may be possible that through the efforts of Sir Humphrey Rolleston, a union will occur which will enable the British radiologists to present a unified effort and will at the same time make possible more rapid advance along many lines.

The aims and purposes of the Radiological Society have been to coordinate all efforts in radiology in North America. This society works in the closest harmony with the Canadian Radiological Society, the American Roentgen Ray Society and the Amercan Radium Society. At the present time, the membership roll of the Radiological Society includes practically all the members of the other societies mentioned. This close relationship should be of great value in promoting research work in America.

The American Roentgen Ray Society has fostered research for a number of years by giving a prize each year to the person who presented the most valuable work on some research problem.

The American Roentgen Ray Society, together with the Radiological Society, has cooperated for several years with the National Research Council, with headquarters in Washington, D. C. Dr. A. W. Crane acts as chairman of the section of roentgenology.

The Radiological Society has been working for some time, attempting to establish an endowment fund for research, the income from this fund to be used in promoting research. A considerable fund has already been accumulated and more is being added. This fund should constantly grow by gifts from individuals and corporations, as well as by annuities and estates left to the Society by will. In due time, a fund of large proportions should accumulate which will make possible investigation along lines needed in radiology and physiotherapy.

Midyear Meeting

THE MIDYEAR MEETING of the Radiological Society will be held in San Francisco, June 22nd and 23rd, the Friday and Saturday preceding the meeting of the American Medical Association.

Those desiring to appear on the program should write to Dr. L. T. LeWald, St. Luke's Hospital, New York City, who is chairman of the program committee, or to Dr. R. D. Carman, President of the Radiological Society. The program is almost complete so immediate action is imperative.

The meeting will be held in Polk Hall of the Civic Auditorium, which has a seating capacity of 1,200. Commercial exhibits will be arranged in wide corridors immediately adjoining the meeting hall, and the scientific exhibits in two reception rooms each about 18 by 30 feet through which one must pass to reach the meeting room.

Dr. W. E. Chamberlain, Stanford University Hospital, San Francisco, is local chairman of the committee on scientific exhibits and would like to have an exhibit of films from as many men as possible. If films can be mailed to him in advance it will greatly facilitate the work of the committee.

The Palace Hotel has been selected as headquarters and 100 rooms have been set aside for use of Society members. The prices of rooms are $8, $9 and $10 a day for two in a room. All rooms have baths. We are informed that those desiring accommodations should write at once since reservations are already at a premium.

Dr. M. P. Burnham is chairman of the local entertainment committee. Preliminary arrangements so far made by this committee are for a dinner and dance at the Palace Hotel the night of June 23rd. For Sunday, the following day, a motor trip is planned to the Santa Cruz big trees where luncheon will be served, thence to the beach at Santa Cruz. This trip comprises a scenic drive of about 100 miles each way. Golfers should note the kindness of Dr. Lloyd Bryan, Butler Building, San Francisco, who will, if notified, make arrangements for any member to play on the local golf courses. Dr. Bryan also announces that visiting cards will be issued to the Olympic Club, one of the attractions of

which is the swimming pool. Besides these entertainments and courtesies the committee has arranged trips to Mt. Tamalpais, to the campus of the University of California and to that of Leland Stanford University.

Wilhelm Konrad Roentgen*

The Discovery.

IT IS LATE in the fall of 1893. The ancient town of Wuerzburg is basking in the autumn sunlight in the vine-clad valley of the Main. In the broad and tree-lined Pleicher-Ring is the Institute of Physics. Within its walls in a room littered with scientific apparatus, a man stands deep in thought before a glass bulb glowing with colored light. He is of middle age, tall, heavily bearded, with a face almost spiritual in its aspect. His brow is broad, the eye, though deeply set, glows with kindness; the lips are thin, the mouth is firm. It is the face of an ascetic and a thinker.

The little glass tube he studies so intently as it glows and flickers with its iridescent hues—what an amount of thought of painstaking, laborious investigation it represents! Pluecker, Gassiot, Geissler, Hittorf, Varley, Crookes, and Lenard and before them all, Faraday—how persistently the human spirit strives to find the meaning of nature's mysteries! How crude the beginning, how halting the progress, how hidden the goal. How slowly the foundations are laid, often without definite plan; the walls rising haphazard, isolated, disconnected, until the master mind sets the cupola and Lo! the structure glows with a beauty and significance undreamed of.

In this vacuum tube, energized by the current of an induction coil, lie many of the mysteries and marvels, not only of modern electricity, but of matter itself—its ultimate constitution—the master problem of the universe. Geissler had passed the induced current through a tube of low vacuum and had produced the exquisite color effects. Hittorf had discovered the cathode ray therein. Crookes noted the change in the phenomena, as the vacuum was increased to about one millionth of an atmosphere. On Hertz's suggestion Lenord brought the cathode stream out of the tube, and studied it exhaustively.

All this was in the mind of Wilhelm Konrad Roentgen, then professor of physics at the University of Wuerzburg, as he watched the flickering bulb. He noted the beautiful green fluorescence of the glass of the tube, just as Pluecker had done thirty-five years ago, and thought of Crookes' designation of "radiant matter" as that influence which apparently radiated from the negative pole.

Absorbed in thought,[1] he did not notice how quickly the hours flew. Called from the room, he laid the still glowing bulb on a book he had been reading that morning, in which lay a large, flat, antique key, which it was his wont to use as a bookmark. It happened that underneath this book lay a photographic plate holder, which he had prepared for an afternoon's outing. Returning later to the laboratory, he gathered up several plate holders, among which was the fateful one under the book, and spent the afternoon outdoors, seeking recreation and amusement in the practice of his hobby, photography. He made several exposures. On developing the plates, a shadow of the antique key, his bookmark, appeared on one of them. He wondered how this could have happened. He showed the plate to his students and asked them for their ideas, but none of the explanations offered satisfied him. How came the image of the key upon the plate? The fogging of photographic plates in the proximity of energized vacuum tubes had been noted before, but to Roentgen's scientific mind this phenomenon demanded a satisfactory explanation and he proceeded to analyze it.

Hertz had said that something passed through the walls of the tube. But these were cathode radiations from the Lenard tube, which Lenard had so thoroughly studied. It was known that these cathode rays, when brought through the aluminum window of a vacuum tube, moved in straight lines, discharged electrified bodies, penetrated thin substances, and affected photographic plates. But this was no Lenard tube with an aluminum window, but a relatively highly exhausted Crookes' tube, and neither cathode rays nor ultraviolet light could pass through the glass of the tube and accomplish this. Roentgen decided therefore to search for the mysterious agent which had so silently recorded its presence. He restaged the drama, placing the glowing bulb, the tube, the book, the key, and plate exactly as before, and energized the tube for the same time as on the preceding day. He developed the plate and Lo! the shadow picture of the key was on the plate. Invisible light? Was some influence emanating from the glowing bulb that had the power of penetrating solid objects and affecting the photographic plate?

Let him who will, speak in admiration of the poetic imagination which soars on spiritual wings in the world of fantasy, singing words that soothe the ear and weaving fancies that stir the emotions. The imagination of the scientist far transcends that of the poet, not only in the scope of its fancy, but surely in concrete accomplishment. The imagination of La Place reached out into the infinite heavens and made possible the measurement of the courses of the eternal stars, the weighing of them as in a balance, their analysis as in a test tube. In the microcosm, the inspired imagination of a Pasteur caused the isolation of a host of organisms, whose destructive and constructive functions are so greatly the concern of medicine.

The imagination of Harvey lifted his eyes from the rutted paths over which legions of physicians since the time

of Galen had traveled, to a newer vista where lay the truth of the physiological problem of the circulation of the blood. So, too, the scientific imagination of Roentgen dared to dream of what was almost scientific heresy, invisible light.

Noting the green fluorescence of the glass of the Crookes tube, he conceived that other substances might be similarly affected. He, therefore, surrounded the tube with a light proof envelope, and sure enough, a platinobarium cyanide screen, even at a distance of nine feet, fluoresced brilliantly green in the darkened room. Eureka! He had it—a ray invisible to the eye which traversed solid substance. He placed his hand on a covered photographic plate, energized the Crookes tube above it, and obtained a photograph of the shadows of the bones.

He at once saw before him the problem in all its possibilities. To study the invisible energy, to determine its nature, its origin, its characteristics, this was the work to be done. He carried on his researches in all phases of the problem, and when convinced at last that he had discovered a new form of radiation, reported his results briefly on two occasions before the Wuerzburg Physicomedical Society, December 28, 1895, and March 9, 1896, in a paper entitled *A New Form of Radiation.* In 1897, before the Royal Prussian Academy of Science, in Berlin, he made a third communication, *On Further Observations of the Characteristics of the X-rays.*

Let the captious critic point out that the placing of the glowing bulb upon a book containing a metal key and under which lay a plate holder, was a fortuitous combination of circumstances, a master stroke of the blind madonna of pagan Chance, but who will doubt, knowing the thoroughness of his methods, that sooner or later Roentgen would have made this discovery as a logical step in his researches?

His Life

Roentgen was born in Lennep, in Eastern Prussia, March 27, 1845.[2] It was planned that he should follow the agricultural occupation of his father, and his scientific education was therefore begun at the engineering school at Apeldoorn in Holland. He entered the Polytechnic School at Zuerich several years later. Clausius was at this time teaching physics in this university, and it cannot be doubted that the young student listened with rapt attention to this great teacher, who developed the principles of the dissipation of energy and first advanced the mechanical theory of heat production.

Roentgen graduated from the university with the degree of Doctor of Philosophy. As a student he manifested an extraordinary aptitude for work requiring exactness in detail, and his industry and ability won him immediately after graduation an assistantship to Kundt, whose favorite pupil he was and with whom he was associated for many years. Roentgen ever held him in highest veneration as his teacher and guide. To him he owed the exactness of his methods, his accuracy of thought, and his thoroughness in investigation. When Kundt was called to Wuerzburg in 1870, Roentgen went with him and, in 1872, followed him to Strassburg, where he became a private lecturer in physics. In 1875, at the age of thirty years, Roentgen was appointed professor of mathematics and physics in the agricultural academy at Hohenheim, but left the following year, at Kundt's request, to return to Strassburg, where he assumed the position of the associate professor, teaching theoretical physics.

In 1879, however, at the age of thirty-four years, he was called to Giessen as full professor and director of the institute of physics. Here he remained for nine years, until appointed director of the physical institute in the great school of Wuerzburg, the second most important university of Bavaria.

It was here that the discovery of the x-ray was made. In 1900, after twelve happy, active and useful years of service, and at the special insistence of the government, he accepted the position of director of the Royal Academy of Technical Physics of the University of Munich, which position he occupied until his death. The presidency of the Royal Physical Institute of Berlin was offered to him, but declined. Honors and titles from all corners of the civilized world have been bestowed upon Roentgen. Immediately upon announcement of the discovery, the Emperor invited him to demonstrate the x-rays at the Palace of Potsdam, where he was awarded the Crown Order of the Second Class. The title of *Excellence* was given him by the German Government and his statue was erected on the Potsdam bridge in Berlin. In 1901, he obtained the Nobel prize for physics, the first of the awards made. The rays he discovered have, by general consent, been named after him. The honors and acclamations of the world never in any way affected the modest, generous, and lovable character of the man. Nor can it be said of him that he ever derived any material gain from his important discovery. He gave it to mankind freely and wholly.

His Work.

Before 1895, his scientific work related to various questions in experimental physics; the examination of the specific heat of gases, the study of isothermal crystals, solar calorimetry, dust figures, aneroid barometry, and the absorption of heat by vapor. Since then his efforts have been mostly devoted to electricity and the phenomena of exhaustive tubes.

In the consideration of Roentgen's scientific labors, one characteristic that stands out above all others is the self restraint shown in his intellectual activities and his reverence for temperate and accurate deductions. His was the mind of a mathematician and his schooling was one in thoroughness, exactness and precision. Indeed, as a keen, inductive thinker he has had no peer in the modern scientific world. Nowhere in any of his productions is there a hasty conclusion based on insufficient premises, nowhere any unfounded generalization. It is always the careful, painstaking work of an investigator, who constantly denied himself the joys of enthusiasm, persistently repressed his emotionalism and the tendency to glorification in his achievement. The constant self questioning, the constant searching analysis of his own beliefs and observations, indicates a mental asceticism which characterizes the highest type of scientific worker. He permits the facts to speak for him. His experiments, therefore, have an elemental firmness, strength, and finality. It is the quality and not the quantity that renders his work of such surpassing value.

We are too near the age to obtain the proper perspective of the personalities which will dignify it, but from the distance of centuries, Wilhelm Konrad Roentgen will be seen as one of the towering figures of our time.

I. Seth Hirsch, M. D., New York City.

Footnotes.

*—A Biographical Sketch. Copyright, 1915, by A. R. Elliott Publishing Company.

1. This episode is based on an account given in *Popular Science Monthly*, December, 1908, by E. E. Burns, who attributes it to Dr. T. S. Middleton, of Chicago, who was a student in Roentgen's laboratory at the time of the discovery.

2. For many of the facts in this biographical sketch I am indebted to A. Sommerfield's article in *Physikalische Zeitschrift*, 1915.

Honor to Whom Honor is Due

DR. CHARLES VAILLANT, French roentgenologist, who for the past twenty years has labored at La Ri-

boisere Hospital in Paris, is another of those scientists whose early researches have demanded a visible toll of the flesh.

Dr. Vaillant, from exposure to x-rays in the early days, suffered the loss of the little finger of his right hand in the year 1919. Since that time he has endured twelve operations until now the right arm is amputated at the shoulder and the left one just below the elbow. Undaunted he still directs the work of his laboratory in La Riboisiere Hospital, and recently France and America combined to show their appreciation of his work in the field of roentgenology.

France, through the person of General Dubail, Grand Chancellor of the Legion of Honor, bestowed upon the scientist the Cravate of the Legion of Honor, one of France's choicest rewards to her heroes. Paris upon the same occasion decorated him with the Gold Medal of the City of Paris, and America, speaking through Myron T. Herrick, our American Ambassador to France, presented him with the Carnegie Hero Medal.

Dr. Vaillant received his honors with modesty and dignity of manner and with a radiancy of spirit shining in his face that has caused witnesses of it to marvel at one who though he has sacrificed so much in his life's work can yet think more upon the joy of his achievement than upon its great cost.

We rejoice that the world increasingly honors its great men of peace. Some day when the futile bickerings of all the nations have ceased there will be time and quiet to look around a little, to do more thinking than is now possible, to better understand, and as a result to reach out helping hands and to speak words of appreciation to all those who, because of the spirit that is in them, are bending their life's efforts toward a happier destiny for the race.

Regarding the Chiropractor

THE movement to exclude from the Journal the advertisements of manufacturers who sell x-ray equipment to chiropractors, is one of those acts of futility which tend to make our profession appear ridiculous in the eyes of the commercial world.

Whatever action we may choose to take, we cannot, even if we desire to do so, prevent the chiropractors or any other group from obtaining in the open market any equipment needed in the practice of their profession. Surely no cult now attempting to diagnose and treat disease has more plainly shown the need of revelations such as the x-rays alone can offer than has the chiropractor. In any event he will not be a greater menace to a long suffering public with this diagnostic aid than without it. As long as our laws permit these perennial cults to treat sick people we cannot, nor should we try to, prevent the sale to them of physical equipment.

How much wiser would it be for the Journal to accept all advertisements of honest goods and use any surplus revenue earned thereby in propaganda aimed toward more strict educational requirements for those who would diagnose and treat human disease.

F. S. BISSELL, M. D., Minneapolis.

NEW EQUIPMENT

A New Deep Therapy Diagnostic Machine Announced

THE January-February number of "Service Suggestions," issued by the Victor X-Ray Corporation, contains further particulars on the "Snook-Special," the new Victor intermediate model combination deep therapy and diagnostic machine. There are a number of features set forth in the descriptive matter that are interesting to note, for they seem to be definite advances in the manufacture of this type of apparatus.

The designers in this instance have again utilized the Snook principles of rectification and claim to have even increased the efficiency and reliability of the original Snook rectifier. This in itself would represent an immediate benefit to the roentgen art.

It seems that first consideration in designing this machine was given to the electro-static field which is set up in high voltage machines, a factor which, as is well known, gives rise to voltage surges and consequent inconsistent operation of the tube, with the tendency to cause damage to the latter. Victor engineers point out the advantages realized in the "Snook-Special," through establishing electrostatic balance throughout the machine. Instead of unequal stresses between machine parts, they have so designed it that these stresses are equalized, as it were, so that no spark-over occurs at any point until the voltage impressed exceeds the maximum capacity of the machine. The end result of this is the elimination of corona between adjacent parts. The theory that such design makes for better tube operation and utmost protection to both machine and tube seems obvious enough.

The voltage capacity of the machine for deep therapy is given as ranging from 30,000 to 200,000; and in milliamperage it has a running capacity of 30 milliamperes which is considerably in excess of the milliamperage capacity of the present Coolidge deep therapy tube.

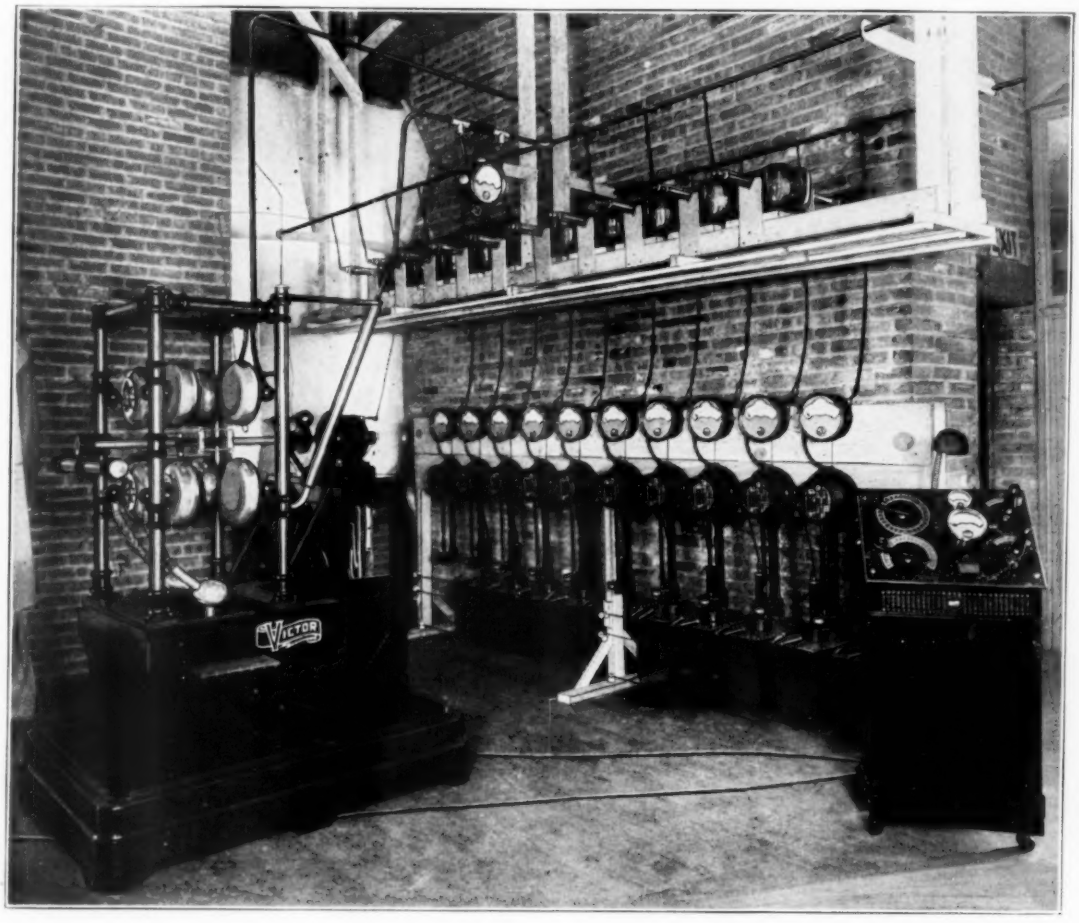
To substantiate all that has been claimed for this machine, the accompanying illustration has been submitted, showing a view in the Victor experimental department, of an "Intermediate" installation by means of which ten Coolidge deep therapy tubes are energized simultaneously, at 200,000 volts with 3 millamperes through each tube. A separate Coolidge transformer and stabilizer set is provided for each tube, as can be seen in the picture. The statement is made that this is the first time, so far as known, where ten tubes are energized by one transformer, at this voltage and milliamperage, and with the machine running constantly.

This installation is also made to demonstrate the value of the Victor-Kearsley stabilizer, for here it is possible to adjust one or more of the sta-

bilizers, independently, to increase or decrease the milliamperage in any of the ten tubes selected, without affecting the milliamperage through the remaining tubes. It is pointed out that this is possible only when the Victor-Kearsley stabilizer is interposed.

Previous announcements of these manufacturers have laid much stress on the importance of the Victor-Kearsley stabilizer in radiography. When we are told that it functions with the same accuracy in connection with deep therapy apparatus, where even the slightest fluctuation in milliamperage is of vital concern, considering the long periods of treatment, then the importance of this accessory to the roentgenologist is increased many times.

The "Intermediate" can be used also as a diagnostic machine, its capacity, according to the designers, providing for all branches of radiography.



CASE REPORTS

Observations of the Development of the Normal Knee

A Preliminary Report

L. R. SANTE, M. D.
St. Louis

ON SEVERAL occasions examination of the knee joint between the ages of about 4 and 8 years revealed a roughening of the articular surfaces of the joint. These examinations at first were made in connection with definite pathological conditions, and on several occasions a mistake in diagnosis was only avoided by a comparison with the normal knee. The writer has seen this condition mistaken repeatedly for an arthritis, and is convinced that it is not generally known that this is a normal stage in the development of the knee jont. Repeated examination of normal individuals between the ages of 4 and 8 years, reveals the condition without exception. Before 3 years of age no evidence is present of the condition and after 10 years the joint surface has again become smooth. The condition seems to begin at the first indication of patellar ossification, and to last until its full development is completed.

One of the conditions in which this was first observed was in a boy who

Fig. 1-a—Polyarthritis with swelling in several of the joints. The irregularity of the joint surfaces was mistaken for a bony destruction, owing to the co-existing effusion. Antero-posterior view.

Fig. 1-b—Examination of the normal knee, however, reveals as much if not more roughening than that encountered in the swollen knee. This is a plate of the normal knee taken for comparison.

had symptoms of arthritis. X-ray examination showed this condition and a roughened, uneven appearance of the lower end of the patella. The condition was diagnosed as pyogenic arthritis, but examination of the other knee revealed the same condition with the exception that the patella appeared smooth. This irregular appearance of the patella at the tendinous attachment of the patella has been observed in three such cases, it probably was the etiological factor in the "arthritis" in these instances. The irregular joint margins are undoubtedly normal. In a case of polyarthritis (?) the condition formed in one knee joint was thought to be due to arthritis, but examination of the other knee revealed that it was normal (Fig. 1).

In still another instance, by reason of this roughened appearance, a beginning osteomyelitis was almost mistaken for an arthritis. The other knee showed a similar appearance (Fig. 2).

In a recent article by Cohn on the normal development of the knee joint, this condition is shown in the accompanying radiographs, but no mention is made of its significance or appearance or of its pronounced character in some instances.

This condition has not been observed in any of the other joints of the body. Investigation is now being carried on to see if the condition exists in animals and if possible to determine its cause.

Fig. 2-a—Lateral view of knee with arthritis and effusion showing less roughening of joint surfaces than the normal knee in the same patient.

Fig. 3-b—Lateral view of normal knee in same patient as Fig. 2-a. Note that the joint surfaces show more roughening than in the affected knee, Fig. 2-a.

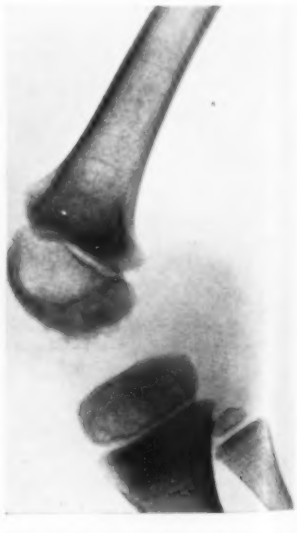


Fig. 3-a—With the finding of an irregularity of the joint surfaces of the knee joint and pain in the lower end of the femur an early osteomyelitis was almost mistaken for an acute arthritis until the opposite normal knee was taken for comparison. Note the periosteal reaction.

Fig. 3-b—Note that the joint surface shows the same roughening as that seen on the affected joint. This is undoubtedly normal.

ABSTRACTS and REVIEWS

Progress and Results in Cancer Control. Frederick L. Hoffman, LL.D., Consulting Statistician Prudential Insurance Co., Boston M. & S. J. 188:221, February 22, 1923.

THE writer believes that the increase in the cancer death rate is a real one but also he believes that cancer control is being more and more realized. It is only the increased effort to combat cancer that keeps the rate as well under control as it is. He says, "Those who are of the opinion that the increase in cancer is more apparent than real, base their conclusions upon guess work, not entitled to serious consideration. The increase in cancer is a world phenomenon." The death rate for 1921 is estimated at 100 per 100,000 in this country and reaches the maximum in San Francisco, California, and in Portland, Maine.

Cooperation between "an aroused medical profession and an aroused public interest" must greatly increase before any marked control of the death rate can be attained. A step in this direction which the author believes may have far reaching consequences is the action taken by the John Hancock Mutual Life Insurance Company which has arranged with the Cancer Commission of Harvard University to give its policy holders free examination for suspected cases of cancer. The examinations are made at the Huntington Memorial Hospital which is fully equipped with the latest and best apparatus. Examinations are made by the regular physicians of that hospital and advice is given free of charge, though, of course, treatment is at the patient's expense.

The Intensive Radiotherapy of Cancer: Is It a New Method? A. Joseph Riviere, M.D., Paris. Medical Review, Paris, March 15, 1922 (Reprint).

IN 1903 A. Darier reported to the Academie de Medecine, Paris, the then startling results secured by the use of deep therapy in a case of generalized lymphosarcoma. Darier had made the histological examination and stated that there was no doubt of the diagnosis. The treatment was applied by Dr. Riviere and consisted of "a daily application of roentgen rays for ten minutes, followed immediately by a local application of ample bi-polar effluvia of high frequency. The rays employed were half-soft, produced by a large bi-anodic Muret tube, influenced by a spark coil of 40 centimeters, whose condensing capacity was 0 microfarad 66. The interruptions (to the number of 1,200 per minute) were supplied by a mercury interrupter worked by a motor. The primary current of the coil measured 60 volts, with an intensity of 6 amperes at the moment of interruption. The quality of the rays corresponded to No. 7 of Benoist's radiochromometre. The anticathode was placed at a distance of 20 to 25 centimeters from the teguments." A radiodermatitis resulted at the fifteenth sitting because the patient, unknown to the doctor, approached too near the tube. This radiodermatitis, however, he believed was rather beneficial than otherwise. Dr. Riviere in his report of this case in 1903 stated that it was necessary, to secure curative results in x-ray treatment, "to employ massive doses of x-rays of different qualities, according to the nature and depth of the anatomical tissue to be traversed."

Not only in 1903 in his communication to the Academy of Medicine, but again in 1907 in his communication to the French Congress of Medicine Dr. Riviere made the following assertions: "(1) That high frequency effluvia and sparks cure malignant tumors, both superficial and deep. (2) That they destroy the neoplastic masses and leave alone healthy tissues. (3) That their action on lymphoid tumors is most marked. (4) That they should, along with x-rays, when applied after operations, serve to prevent recurrence of the malignant tumors. (5) That physicotherapy is the only resource in cases of inoperable tumors. (6) That doses of roentgen rays must be massive without damaging the teguments. (7) That radiodermatitis seems sometimes to promote and favor cure. (8) That it is indispensable to drive the necrosed parts to elimination on account of their return to the general circulation. (9) That the neoplastic cell did not derive benefit from the synergic forces of healthy tissues controlled by the nervous system. (10) That it is always necessary to give attention to the general conditions of the organism as well as to the local condition. (11) That in the presence of an evil so tenacious and so disturbing as cancer, we must know how to proportion effort to resistance, and bring judiciously into play all the resources of the physicotherapic arsenal."

On the Gamma-Ray Action of Extensive Flat Radium Preparations at Different Distances with and without Absorbing Materials. Victor F. Hess, M.D., Physical Review 19:73-79, February, 1922.

IN THIS paper Dr. Hess deduces the mathematical expression for the intensity of gamma radiation at points lying upon the perpendicular line passing through the center of a circular plaque. He also tabulates the values so computed for various distances, varying from 0.3 to 10 cm., from plaques of diameters of 0.4. 1, 2, 4, and 8 cm.; the radiation is supposed to be filtered through 2 mm. of brass. He also gives the corresponding values for an uncovered plaque 4 cm. in diameter, and the values in tissue for the same plaque when covered with 2 mm. of brass and placed directly upon the tissue. As stated, it is solely the gamma rays that are considered; the soft rays arising from the filter are supposed to be absorbed by the interpostion of a suitable layer of a substance of a low atomic weight. The hard primary beta rays are not considered. The coefficient of absorption of the gamma rays in tissue is taken as 0.094 $cm.^{-1}$ which corresponds to a half-value thickness of 7.4 cm. The intensities are expressed in terms of the intensity in air at a distance of 1 cm. from a point source containing 1 mg. of radium. This is often denoted by writing after the number denoting the intensity the notation "mg/cm^2" (read "milligrams per centimeter-squared") denoting that it is arrived at by dividing the number of milligrams by the square of the distance expressed in centimeters. The author proposes that this intensity be called a "milli-eve." The effect of the scattering of the radiation by the tissues is not considered. Attention is called to the fact that though the intensity near the disk varies greatly with the size of the disk, the amount of radium being the same for all, the intensity in air at 3 cm. from the disk is nearly the same for all the disks considered. A more useful fact to remember, however, is that beyond a distance equal to the diameter of the disk the intensity in air is essentially the same (within 5 per cent or less) as if the radium were concentrated in a point at the center of the

disk; at points lying near the disk the intensity is much less than it would be if the radium were so concentrated.

DR. N. E. DORSEY.

Investigations of the Secular Variations of High Tension Direct Currents, Both Intermittent and Pulsating. Friedrich Voltz, Arch. f. Elektrotechnik, 9:247-278, 1920.

THE author investigates the time variation in the current through x-ray tubes of various types when excited by the "symmetrie" apparatus, and also considers briefly the case of a tube excited by one of the usual types of interrupterless machines.

When a Lilienfeld tube is excited by a symmetrie apparatus, each discharge through the tube consists of a series of partial discharges. These result from electrical oscillations set up in the exciting apparatus; they become less pronounced, and the total duration of the discharge is reduced, by increasing the capacity of the condenser which bridges across the interrupter; increasing the voltage on the tube somewhat enhances the effect of increasing the capacity of the condenser.

When a Coolidge tube is excited by a symmetrie apparatus, each discharge is likewise broken up into a series of partial discharges if the capacity of the condenser is small. But the partial discharges are not distinct, as with the Lilienfeld tube, but are crowded together. As the capacity of the condenser is increased, the discharge soon becomes almost constant, the current jumping nearly instantly to its maximum value and staying there until very near the end of the discharge, when it abruptly drops to a very low value. The total discharge is in every case spread over a much shorter tmie than in the corresponding case with the Lilienfeld tube.

When a self-hardening, boiling, gas tube with an automatic regenerator is excited by a symmetrie apparatus, each discharge consists of a series of partial discharges that are not distinct, but appear as a fluctuating secondary discharge superimposed upon the main discharge. These secondary discharges become less distinct as the capacity of the condenser is increased. The main discharge rises and falls more gradually than in the case of the other two tubes, and is spread over a longer interval.

When an x-ray tube (type not stated) is excited by an interrupterless machine with mechanical rectification of the secondary current, partial discharges are generally present. These are attributed to the sparkinng that occurs at the rectifying switch, and it is stated that they can be very completely eliminated; but how it can be done is not stated.

The observations recorded are not sufficiently numerous nor varied to enable one to decide how far the recorded differences between the effects observed with different tubes are really characteristic of the tubes themselves.

DR. N. E. DORSEY.

Continuous X-Ray Spectrum. H. Behnken. Zeitschr. f. Physik. 4: 241-253, 1921; Applied Voltage and the Quality of the Radiation Emitted by a Coolidge Tube. H. Behnken. Zeitschr. f. techn. Physik. 2:153-160, 1921.

THESE papers are contributions from the Physikalische Technische Reichsanstalt, the German institution that corresponds closely with our National Bureau of Standards. They are reports of different aspects of the same work, and consist of mathematical discussions of observations that have been made by others upon the continuous x-ray spectrum emitted by a Coolidge tube at voltages below 70 kv. Though the data apply directly only to voltages lying below those used in practice, and so give only incomplete information upon the questions of direct interest to radiologists, they do not in this respect differ in any essential from many similar data that are given in papers appearing in radiological journals, and they do serve to bring out certain conclusions that are at least qualitatively applicable to higher voltages.

The radiologist will probably be most interested in the second of these papers and especially in the figures accompanying the latter. In one figure the author gives a series of curves showing the amount of energy of each wave length absorbed by a fixed volume of a thin surface layer. The radiation is unfiltered and is emitted by a Coolidge tube. Curves corresponding to various constant voltages are given; the number of milliampere-minutes being the same in all cases. It is interesting to note that the portion of the spectrum from which the greatest absorption occurs changes very little with the voltage, provided the latter exceeds 50 kv.; this region of maximum absorption is very close to wave length 0.64 Angstroms. This means that for surface effects depending upon merely the relative amounts of energy absorbed from various wave lengths, the quality of the radiation does not change greatly above 50 kv.

Another similar figure applies to filtered radiations emitted at a single constant voltage. These curves show that filtering shifts the region of maximum absorption sharply towards the shorter wave lengths. The effect of a 5 mm. filter of aluminum shifts this maximum from wave length 0.64, corresponding to no filtering, to 0.38, thus changing the quality of the absorbed radiation very materially. In so far as absorption by the surface layer is concerned, increasing the voltage has a hardening effect that is insignificant as compared with that produced by filtration.

In another figure curves are given comparing the distribution of energy in the spectrum of the radiation emitted by a Coolidge tube run on a sinusoidal voltage with that emitted by one run on a constant voltage equal to the peak value of the former; two milliampere-minutes are the same in both cases. As is well known the most intense radiation occurs in essentially the same part of the spectrum in both cases. Two striking facts that are seldom discussed in radiological journals are exhibited by these curves and the table accompanying them. First, for the same number of milliampere-minutes, the amount of x-ray energy emitted by the tube run on the sinusoidal voltage is only about half as great as that emitted by the one run on the constant voltage. Second, if the current through the tube run on the sinusoidal voltage is increased until the energy emission in the most intense portion of its spectrum is equal to that in the most intense portion of the constant voltage spectrum, then the amount of energy emitted at a wave length that is essentially shorter than that corresponding to the most intense portion of the spectrum will be perceptibly less; also that emitted at a wave length that is essentially longer than that corresponding to the most intense portion of the spectrum will be perceptibly greater than that emitted at the same respective wave lengths with constant voltage. The further the departure from the maximum, the greater does the ratio of the energies in the two spectra depart from unity. Hence, if concerned with an effect that depends not upon merely the relative amounts of energy in the various portions of the spectrum but upon the actual amount of energy contained within a limited portion of it, then, if this portion is essentially different from that in which the bulk of the energy is distributed, the sinusoidal spectrum is for this effect appreciably safer than that emitted by a constant current. If the effects considered are of the other kind, the two radiations are of essentially the same quality. These two different aspects of the same change have exact optical counterparts that are well known to all. The most intense portion of sunlight lies near the yellow. Even though quite a percentage of the violet were removed from the sunlight and were replaced by a

corresponding amount of deep red, but a slight change would be visible, but a very great change would have been produced in its photographic effect. In relation to vision, the quality of the light would have remained essentially unchanged; but in relation to its photographic effect, its quality would have been profoundly changed.

In this connection it is interesting to consider the radiations that result when the voltage varies in other ways. It is evident that the resultant radiation is merely the sum of the radiations that are emitted during each successive very small interval of time. The resultant mixture is not solely a question of the voltage changing from one value to another, but is primarily a question of the number of milliampere-minutes expended at each little step in the transition. As the author points out, if the voltage jumps abruptly back and forth from zero to a certain high value, the resultant radiation is the same as if the voltage had remained continuously at the high value: all of the milliampere-minutes are spent at that voltage. The same applies to a tube operated upon an interrupterless transformer with a mechanical rectifier. If the milliampere-minutes expended during the jump from zero voltage to a voltage near the peak of the curve is negligible, then the resultant radiation will be of the same quality as if the tube had remained continuously at these high voltages. If, however, oscillations, as described by Voltz (see preceding review) are set up, the radiation has a quality that corresponds to a sinusoidal voltage, or may be even softer than that. It must be remembered that the difference in softness of which we are now speaking is entirely negligible unless one is concerned with the actual amount of radiation that is carried by a portion of the spectrum that lies appreciably outside the region within which the bulk of the energy is found.

DR. N. E. DORSEY.

A Separate Centre of Ossification for the Tip of the Internal Malleolus. H. A. T. Fairbanks, M. S., F.R.C.S., Arch. Radiol. & Electroth. 27:238, January, 1923.

THREE cases of a separate center of ossification for the tip of the internal malleolus on both sides is here reported. All cases were found in girls of about ten years of age. A diagnosis of sesamoids is agreed to be out of the question by all who have looked at the plates.

A Hitherto Undescribed Bone in the Tarsus. Percival D. Cameron, M.D., Dunedin Hospital, N. Z., Arch. Radiol. & Electroth. 27: 234, January, 1923.

A BONE forming a distinct projection on the inner side of the foot, lying in the angle between the scaphoid and internal cuneiform bones was found by this author in a 24-year-old patient. There was also a "quite definite tibiale externum lying in close contact with the head of the astragalus, between the scaphoid and the sustentaculum tali. Neither of the extra bones was present in the foot of the other side."

Professor Gowland of Otago University suggests that this bone may be the apophysial element of Manners Smith (see J. Anat. & Physiol. 41: 255), or possibly the paracuneiforme of Dwight (see Dwight: *A Clinical Atlas: Variations in the Bones of the Hand and Foot*, 1907, J. B. Lippincott, Philadelphia and London).

Fracture of the Ulnar Styloid Process. Hans R. Shinz, M.D., Deutsch. Zeitschr. f. Chir. 175:81-133, November, 1922.

THE following is the author's summary of this rather lengthy paper:

1. Normally the ulnar styloid process ossifies as a part of the distal ulnar epiphysis.

2. In some disturbances of ossification in connection with endocrine anomalies there may appear an independent center of ossification for this process.

3. Pfitzner's anatomical finding of an os triangulare may be considered a broken off process which has healed and formed a pseudoarthrosis.

4. Even Thilenius' embryological evidence for the presence of an anlage of cartilage which may later ossify independently as an atavistic supernumerary os triangulare is not puncture proof.

5. Fractures of the styloid process frequently occur in cases of sprain of the wrist; these either heal and form a pseudoarthrosis or become absorbed.

6. Every classical fracture of the lower end of the radius with the classical displacement is necessarily accompanied with a fracture of the ulnar styloid process.

7. In the supracondylar fractures of the radius, about an inch above the articular surface of the wrist, there is almost always found a fracture of the ulnar styloid process. In subperiosteal or in green stick fractures, the ulnar styloid process is broken off if already ossified, but if not, a fracture of the epiphysis or chipping of the same may occur.

8. Epiphyseal separation of the radius with dislocation is accompanied with epiphyseal separation of the ulna as well, and may or may not be accompanied with fracture of the styloid process.

9. Luxation of the distal end of the ulna is accompanied by a fracture of the styloid process. Where luxation has become habitual there is often found a traumatic os triangulare.

10. Semilunar dislocation is accompanied by the ulnar styloid fracture. It does not occur with fractures of the os naviculare. True semilunar fractures are usually accompanied by the fractured styloid.

A. M. PFEFFER, M. D.

Congenital Radio-Ulnar Synostosis. E. Sonntag, M.D. Bruns Beitr. z. klin. Chir. 120:716-720, 1922.

THE patient was a boy of 17, who could not very well perform his duties as a baker because of limited supination on both sides. Roentgenographic examination revealed synostosis of the radius and ulna on both sides.

The author had two cases, both boys, each of whom had a double synostosis, and in each case the changes on both sides were not quite equal, the one of the right side being functionally and structurally better, otherwise the elbows and the forearm bones were well formed. Flexion and extension was almost normal and while the musculature was somewhat weak, there were no appreciable defects. Neither case presented any other malformation. Both patients, by using the shoulder joints, were able to perform their duties, and refused operative interference. Neither of them was able to carry anything on the palms of the hands as the position of the hand was always in the pivotal axis. During eating, the spoon could not be held in the usual position but had to be grasped at the tip with the thumb below and the fingers above and brought to the mouth not by leverage but by mere lifting.

The author summarizes this abnormality as beng congenital, hereditary perhaps (one boy had an aunt similarly afflicted), of rare occurrence, with definite symptoms, easily diagnosed by the roentgen rays. Operative interference is the only therapeutic measure.

A. M. PFEFFER, M. D.

Development and Termination of Osteochrondritis Deformans of the Hip (Legg's, Calve's, Perthes' Disease). Drs. Perthes *and* Welsch. Bruns' Beitr. z. klin. Chir. 120: 477-225, 1922.

THE authors observed both clinically and roentgenologically the complete progress of 14 cases of osteochrondritis deformans coxae juvenilis from the beginning until the final arrest. Healing of the bone processes with excellent restoration of the joint function finally

resulted. The duration of the transition from the florid stage until the final arrest was found to be an average of four and one-half years.

Healing results in two typical forms of the head of the femur, the globular form, and the mushroom form. The contrast between the deformity and excellent restoration of function is particularly noteworthy. The best function is obtained in the globular form, while there is some moderately pronounced limitation of motion in the mushroom form.

The roentgen findings of the florid stage showed the epiphysis of the head of the femur markedly reduced in height, and the contour flattened. Within the normal bone shadow circumscribed radiolucent areas were observed, and in some cases the whole epiphysis appeared as if split into several fragments. Through histological examination these radiolucent areas penetrating the epiphysis have been found to consist of projections of cartilage which often connect the articular with the epiphyseal cartilages. With the flattening of the epiphysis there is naturally produced a widening of the same so that it projects farther out than the neck of the femur, it may be entirely displaced laterally. The lateral portion gives way to the pressure influence earlier than the medial portion.

The epiphyseal line remains unchanged even after there is definite destruction of the head, although the persistence of this line does not prevent the disease process from extending into the neck, which gradually enlarges. The portions adjacent to the epiphyseal line contain radiolucent areas, due to cartilaginous deposits. As a result, the neck becomes weakened and giving way to static pressure becomes wider and shorter. At first the line appears serpiginous, but in time becomes entirely lost in the chaos of newly formed deposits and bone changes.

Five cases showed the globular form of end result where the destructive process had not extended across the epiphyseal line. The head became homogenous in appearance, the translucent lesions were no longer present. The head was rounded and the joint space was regular. Abduction and rotation were free, and there was no shortening of the limb and no limp resulted even after much walking. Of course, the projection of the normal hip upon the healed one shows some changes.

Nine cases belonged to the mushroom form of end result. The unchanged head in this form appears like a cylinder or mushroom. The reduction of the height of the head as well as the widening and enlargement of the epiphyseal line and the neck were marked. The cartilage islands disappeared and the shadow was homogenous. Movement was limited by those changes, as well as by a thickening and enlarging of the trochanter. Flexion and extension were normal. There was some shortening of the limbs. Subjective symptoms were not complained of.

The authors find this disease entirely different from arthritis deformans juvenilis, which is supposed to be analogous to the arthritis deformans of older patients. Nor do they accept Fromme's idea who believes this disease to be a form of late rickets.

Etiologically the authors do not accept the idea of trauma being the causative factor as proposed by Legg and Schwartz, but they are inclined to agree with Brandes and Zoijer who consider it a developmental defect analogous to the Schlatter-Osgood form or to Koehler's disease, like the osteochondritic conditions of the head of the second metatarsus, or of the elbow. They emphasize that the pathology consists of a proliferation of cartilaginous deposits at the expense of the bone substance.

As to treatment, the authors found no definite influence resulting from any treatment. Operative measures are not indicated, as the prognosis is good.

A. M. PFEFFER, M. D.

Leontiasis Ossea. Drs. Lesne *and* Duhem. Rev. Neurol. 29:1176-1179, September, 1922.

THE authors report a case of a patient 51 years of age whose complaint was of a gradual enlargement of the head, unaccompanied by deformity or subjective symptoms. The mother, but no others in the family, presented a similar condition.

Since childhood there had been noted an abnormal prominence of the upper maxilla. The patient had been normal in every way, and possessed more than the average intelligence having devoted twelve to fourteen hours daily to mathematical studies.

The head measured 66 cm. in circumference, 23 cm. in the anteroposterior diameter and 17½ cm. transversely. The maxillae were markedly prominent, so that the nose was almost completely effaced. Yet the cranium was symmetrical and uniform.

The roentgenograms revealed a generalized diffused hyperostosis; there was no obliteration of the nasal cavities but a condensing ostitis, more pronounced on the right side, did not permit the usual translucency of the maxillary and ethmoidal sinuses.

The orbits were decreased in size in both directions. The entire vault of the skull was markedly thickened with no uniform condensation of bone. The thickening, however, extended only outwardly, as the inner table was quite smooth, which explains the absence of any subjective symptoms. The thickness of the vault was about 2½ cm.

The base of the skull was also thickened irregularly, but no osseous tumors could be noted. The sella turcica was slightly smaller in size, but smooth.

The mandible was not affected nor were any other bones in the body affected.

Due to the fact that only the bones of the cranium were involved the author did not accept the diagnosis of Paget's disease. The pathological appearance of the radiogram did not agree with that of Paget's.

The point in the history regarding the prominence and enlargement of the superior maxillae ever since his youth, was in favor of the diagnosis of leontiasis ossea.

The authors review the scant literature on the subject, and refer to a few skulls, found in museums, which have been wrongly diagnosed leontiasis ossea. The authors discuss at some length the points of difference.

They have, however, found one skull which proved to be very interesting, as it was supposed to be a very ancient skull of some prehistoric human type. It was found at a depth of five meters in 1759 and given to the museum by Bernard de Jussieu. The authors found in that skull a true resemblance to their own case, the radiographic evidence of the similarity being very striking.

The paper is accompanied by four radiographs, those of the living case side by side with those of the supposed prehistoric fossil.

A. M. PFEFFER, M. D.

Tibiofibular Synostosis. Hans Rahm, M. D. Ztschr. f. orthop. Chir. 43: 64-69, January, 1923.

WHILE numerous reports have been made of cases of radio-ulnar synostosis (Kienboeck collected 36 cases in the literature in 1911), there has not appeared in the literature any report concerning tibiofibular synostosis.

The author's case was one of a 43 year old woman who came to be treated for a painful right knee. Examination revealed marked right genu valgum with absence of the normal prominence of the head of the fibula. There was some crepitation in the joint which was explained as due to arthritic changes. The roentgenogram showed some bending of the tibia, particularly marked in

the upper portion, in the reigon of the tibiofibular synchondrosis. The fibula was shortened, curved in its upper portion, and its head formed a synostosis, with the tibia joining it posteriorly and somewhat below the normal position of the head of the fibula.

The author applied Maass' theory of pressure on the epiphysis in the radio-ulnar synostosis to this case. While he admits that the condition may be hereditary in nature, or that it may be the result of some developmental defect, he is inclined to believe that the abnormality of the tibia was primary while the fibular anomaly was secondary and of mechanical origin. The constant pressure on the epiphysis of the head of the fibula, exerted by the faulty shape of the tibia, interfered with the normal growth and development of the fibula thus giving rise to the synostosis.

The author believes that a routine roentgen examination of all cases of genu valgum will reveal a larger number of synostoses similar to his own case, so that a better study could be made of its pathogenesis.

A. M. PFEFFER, M. D.

A Hitherto Unrecognized Disease of the Patella. Swen Johansson, M.D. Ztschr. f. orthop. Chir. 33:82-87, January, 1923.

FOUR cases are reported which occurred in children of 12 to 13 years of age with normal family history. These patients complained of more or less severe pain, in one or both knees, provoked by slight injuries. Examination revealed some swelling and tenderness in the lower portion of the patella. Roentgenograms revealed a few loose particles of bone around the tip of the patella, these particles having completely rounded contours without any indication of the presence of lines of fractures, some periosteal deposit was observed slightly above the tip, with swelling of soft tissues corresponding to the affected area. Two of the four cases showed similar changes in the tibial tubercles. The tarsal navicular bones were found to be normal.

Rest and splinting for several weeks brought complete relief of pain with full use of the knee. The roentgenograms then showed a mere thickening of the apex of the patella.

The navicular bones were examined because of Koehler's observation that in Koehler's disease (abnormal changes in the navicular of the foot) there may occur bone changes in the patella as well.

In discussing this abnormality of the patella the author finds it greatly resembles Osgood-Schlatter's disease which designation has been applied only to the tibial tubercle. Both of them present distinct circumscribed tenderness to pressure without any definite inflammatory symptoms. Both occur at the ages of 10 to 13 before ossification of the epiphyses. The prognosis and course of the disease is strikingly similar in both conditions. In both conditions the bone changes vary considerably, appear to be provoked by slight trauma, and localized about the insertion of a tendon.

The author discusses the possibility of these changes representing ossified particles within the tendon, and also the possibility, since some patellae have been known to have two ossification centers, of the pull of the tendon preventing union with the lower portion.

He summarizes the condition as being identical clinically, etiologically, and roentgenologically with that of Osgood-Schlatter's disease of the tibial tubercle.

A. M. PFEFFER., M. D.

A Case of Congenital Anomaly of the Spinal Column. George Wehner, M.D. Ztschr. f. orthop. Chir. 43: 123-126, January, 1923.

A RARE case is described of a child three and one-half years of age, who when presented for examination showed a marked sharp flexion of the spinal column, and club-feet. Incontinence of urine, difficulty in sitting up, general poor nutrition, and spastic condition of muscles of the legs were further complaints.

Roentgen examination revealed only rudimentary development of the first, second, and third lumbar vertebral bodies with complete absence of the arches of these vertebrae.

The author believes this case justifies the theory of Putti that the bodies of the vertebrae arise from different embryonal structures than their arches, and that there is some relation between the two so that one can not develop as well in the absence of the other.

The presence of club-foot in this case according to the author, is secondary to the malformation of the spinal column. Peltesohn and Beck have called attention to the frequency of spina bifida in congenital club-foot. The degenerative changes of the congenital defect of the cord or of the muscular nerves brought about the disturbance of the equilibrium and the club-foot condition. The spasticity, limitation of movement, and the urinary disturbance prove that it is of cord origin.

Therapeutically the correction of the club-foot, and the implantation of two bone grafts, one on each side of the column, should be attempted. A supporting corset should be worn.

A. M. PFEFFER, M. D.

The Secondary Effect of Scoliosis on the Internal Organs. Theodore Toepel, M.D., J. M. A. Georgia, 12:77, February, 1923.

THIS paper describes the effects as noted in the title and makes a plea for recognition by physician and educator of the early and mild changes which first accompany the deformity. If this were the practice structural changes need not take place and the pathology due to these would thus be prevented.

A New Lighting Arrangement for the Roentgenoscopic Room. E. Hoeger, M.D., Muenchen. Med. Wchnschr. 69:594, 1922.

IN THE red light ordinarily used in the roentgenoscopic room the adaptation of the eyes to the darkness undergoes considerable disturbance. The weak light of the screen is perceived by the rod apparatus of the retina, and as the specrum of this light contains the red rays it follows that the red light preceding the screen examination weakens the visual capacity for the screen light. So it is necessary to obtain a kind of light rays sufficient to visualize objects in the room, and which will not enter into the composition of the spectrum of the screen light. The author succeeded in producing a glass filter to envelop the source of light in the room, by which he accomplished the desired end. These filter glasses can also be used for adaptation eye glasses. They can be obtained from the firm of Koch & Sterzel, Dresden.

A. M. PFEFFER, M. D.

New Roentgen Ray Findings in Cord Tissues. Max Segalitzer, M.D. *and* S. Jatrou, M.D. Mitt. a. d. Grenzgeb. d. Med. u. Chir. 35: 598-610, 1922.

ONLY tumors of the spinal cord affecting the bony portions of the column, or bone tumors affecting the cord are usually believed to be demonstrable by roentgen ray methods. The authors, however, made the observation that certain tumors of the cord or of its coverings give roentgen ray signs. The following findings are described:

In nine out of ten extramedullary tumors, the roentgen ray examination revealed small exostoses in the edges of the vertebrae of a strictly circumscribed segment of the column. The remaining vertebrae and all other bones and joints of the body were entirely free from these findings.

Three of these nine cases showed sharp and pointed excrescences in the

edges of the bodies of the vertebrae at the level where the tumors were located. These tumors were found in the ventral position. In the majority of the dorsally placed tumors the exostoses were found somewhat below the position of the tumor.

Of five intramedullary tumors, four showed no exostoses. The case which showed exostoses had a tumor of unusually large size occupying the whole cervical region.

The authors conclude that positive roentgen ray findings (exostoses in the vertebrae of a circumscribed segment of the column in an otherwise normal column) may be considered contributory evidence of the presence of a cord tumor.

Negative findings do not exclude its presence.

If no definite diagnosis can be made regarding the location of the tumor from neurological examination, the laminectomy should be attempted at the level of the exostoses, and if not found there the laminectomy should be extended upward and not downward.

The paper is accompanied by a table containing the clinical and roentgenological findings, compared with the operative and postmortem findings, also by a drawing of the appearance of the exostoses.

A. M. PFEFFER, M. D.

A Simple Method of Treating Superficial Lesions of the Perineum and Intra-Pelvic Conditions from Below. Maurice R. J. Hayes, F.R.C.S.I., Dublin. Arch. Radiol. & Electroth. 27:249, January, 1923.

COMFORT, safety and simplicity are the merits claimed for this method which is made possible by the device described in the following paragraph from this article:

"Doubtless other radiologists have experienced similar difficulties in treating this region, but I have found the following solution of it to be so simple and so satisfactory that it appears to me worthy of note. It consists of an ordinary board fashioned like a lavatory seat, but having a circular opening four inches in diameter, which I place across the end of the frame of my radiographic couch, the top of which latter can be easily lifted off. The couch I use is the War Office pattern universal x-ray couch supplied by the Medical Supply Association. In this couch the tube box has longitudinal, transverse, vertical and rotary movements, with simple devices for carrying filters, lead glass nozzles of various sizes, and a pastille holder, and it is capable of very easy adjustment in all directions.

"When the patient is seated, the anal region, the perineum, or the vulva may be readily exposed. There is no risk of sparking to the patient's limbs, and there is no discomfort. A small opening in the seat is essential because it helps to keep the buttocks separated."

Radiotherapy of the Hypertrophied Prostate. Albert Perez, M. D. J. de med. de Paris, 42:36, January, 1923.

DR. PEREZ describes Nogier's technique for this treatment. The uncomfortable position which the treatment has heretofore necessitated Nogier has overcome by an ingenious piece of apparatus which holds the patient in a most comfortable position for as long as an hour at a time. The trunk and extremites are supported but the perineal surface is fully exposed.

Radiotherapy presents less inconvenience and risk than does surgery and is absolutely painless. By Dr. Nogier's method the seances do not last more than an hour and the necessary total dosage is soon accomplished. There is no risk of infection, no hemorrhage and no mutilation. The patient soon shows functional improvement and the more cheerful outlook which follows this has its effect upon the progress made. The surrounding parts are protected by a leaded glass device which permits irradiation of only the perineal parts, and suitable filters are of course used to protect against any radiodermatitis.

Because of the simplicity and efficaciousness of this form of treatment it should be tried before surgical intervention is employed, though this is necessary in rare cases where the fibrous tissue of the prostate is so abundant that it resists ray treatment.

The simplicity and mildness of radiotherapy for this type of disease the author believes will lead to its employment in most cases of malfunction of the organs of the urinary tract in patients past middle age.

Concerning Perirenal Insufflation. Drs. Chevassee *and* Moingot. J. d'urol. med. et chir., 13:54-57, 1922.

THE technique is not safe, and by no means free from risk and the roentgenograms obtained are difficult to interpret. One patient complained during insufflation of a sudden pain between the scapulae and of a choking sensation. The emphysema in the scapular region became palpable immediately. The path of the air movement was followed with the roentgenoscopic screen. It was seen to encircle part of the edge of the diaphragm, reach to the pericardial region and rise behind the sternum and clearly demonstrated the contours of the thyroid. The Corelli method (vertical puncture at a level of the second lumbar vertebra with the patient on the abdomen) often causes the gas to go through the psoas muscles.

The liver and spleen are often found in the area of insufflation. Marion, whose technique was carried out by Carelli himself, observed one case where the insufflation penetrated into the abdominal cavity, and one case where there resulted an emphysema in the neck region.

A. M. PFEFFER, M. D.

An Experimental Study of Various Chemicals Used in Pyelography. Oswald Swinney Lowsley, M.D. *and* Henry R. Muller, M.D., J. Urol. 9:1, January, 1923.

THIS article first briefly reviews the history of injections into the ureter and kidney pelves. Carelli's method is commented upon. The authors say that the injection of 200 to 600 c.c. of CO_2 into the perinephritic space is followed by absorption within one and one-half hours and is not accompanied by the great pain that so often accompanies pneumoperitoneum.

In the authors' use of sodium iodide no serious general reactions have been encountered in their clinical practice though they say, "Practically all cases upon whom a pyelogram is done suffer some discomfort due to the dilatation of the pelvis and ureter. This usually lasts only a few minutes but there may be a persistent ache for a longer period."

The method is thus described: "The patient is cytoscoped and ureters catheterized with lead catheters in the usual manner. Specimens are collected and sent to the laboratory to be examined bacteriologically (culture), chemically and microscopically. A phenol-sulphonephthalein test is then performed to determine the efficiency of each kidney before a pyelogram is done. Two radiograms are taken before the injection of the opaque material, one of the kidneys and upper ureters, and one of the bladder and lower ureter. Twenty per cent sodium iodide is then injected*** as soon as the patient begins to complain of a feeling of fullness some of the solution is allowed to run out and he is radiographed as above. A fifth radiogram is taken with the patient in the erect position * * *, the catheters having been withdrawn to the urethral orifices and sodium iodide injected during this withdrawal."

The authors have found sodium iodide, 20 per cent, more satisfactory as a medium than any other solution they have used. It casts a deeper shadow,

is non-toxic, non-irritating and is easily prepared.

Hydronephrosis, tumors, even very small ones, as well as small malignant ulcerations of the kidney pelvis may be detected. Renal malformation is easily detected. Stricture of the ureter is beautifully and positively demonstrated. It is of more frequent occurrence in both men and women than used to be supposed.

Stones in the kidney may or may not be revealed by the x-ray. "A large stone which does not cast a shadow in the radiogram will show a thinning out of the shadow of the pyelogram at that point. If a shadow occurs in the kidney region a pyelogram will demonstrate its exact position in relation to the pelvis and therefore may be of great assistance in determining whether operation is necessary or desirable."

Fever, subacute infection, or a great deficiency in both kidneys contraindicates pyelography. The aged, the emaciated, or those in a temporarily weakened condition are excluded from this form of diagnosis.

Perirenal Insufflation of Oxygen. Wm. C. Quinby, M.D., J. Urol. 9:13, January, 1923.

IN THIS paper and in the discussion following it the beautiful pictures secured by Carelli's method of injection of CO_2 are remarked upon but the difficulties of the technique are held out as a warning.

The author reports his own excellent results secured by the injection of oxygen. Details of his technique are fully given. He says that the operator with any reasonable powers of visualization and knowledge of anatomy should not encounter any such occurrence as mediastinal emphysema or penetration of the bowel. Untoward results have followed in only one case in the author's practice and were due to adhesions about the kidney, the result of a previous surgical operation.

Conclusions are: "First, that the method is of no danger in properly selected cases; second, that the technique of its production is relatively easy; third, that in certain instances it may be of definite aid in arriving at a diagnosis in properly selected cases, but fourth, that in the majority of cases stereoscopic pyelograms well made will give all the information necessary or obtainable by the further injection of gas."

Carelli-Sordelli Method of Renal Pneumoradiography. Drs. Delherm *and* Laguerrier. Presse. med. 30: 133-134, 1922.

THE ordinary roentgenographic methods fail to demonstrate the kidney shadow in 25 per cent of the cases, and even calculi can not always be demonstrated. Pathological changes can not be demonstrated in most cases. Carelli and Sordelli conceived the idea of air injection into the renal capsule in a manner similar to the pneumoperitoneum method.

The apparatus consists of two glass containers, connected by a tube, one contains oxygen or carbon dioxide and the other contains colored water. With the aid of a rubber ball the water is forced into the gas containing cylinder thus forcing the gas into a rubber tube connected to the lumbar puncture needle used for injection, the quantity of gas can thus be gauged accurately.

The technique is as folloys: With the patient lying on the abdomen the transverse process of the second lumbar vertebra is found by roentgenoscopy and the needle is inserted immediately above and at the outside of the transverse process, slightly bent cephelad. The deep layer of the fascia lumbodorsalis is pierced. This is accompanied with slight resistance, the needle is then lowered for one or one and one-half centimeters and if the needle is in the proper position there will be oscillations of the manometer synchronous with respiration. One must be certain that there is no blood or pus in the needle lumen before it is connected to the gas container.

About 300 to 400 cc. usually produces a feeling of slight tension and is sufficient. The needle is then withdrawn, the patient placed on the back and roentgenograms made. CO_2 absorption is very rapid, so when one is not fully accustomed to the use of the method, oxygen is to be preferred.

The author found this method very useful in a few cases.

A. M. PFEFFER, M. D.

Roentgenography of Urinary Tract During Excretion of Sodium Iodid. Earl D. Osborne, M.D.; Charles G. Sutherland, M.D.; Albert J. Scholl, Jr., M.D.; and Leonard G. Rowntree, M.D., J. A. M. A. 80: 368, February 10, 1923.

THIS article reviews the use of various mediums in the urinary tract and gives in detail the authors' method of administering sodium iodid, and their roentgen technique.

Conclusions are thus stated: (1) "By the method described, it is possible to obtain roentgenograms of the urinary tract during the excretion of sodium iodid following its intravenous or oral administration. (2) The method uniformly gives excellent and accurate shadows of the urinary bladder and renders reliable information relative to its size, shape, and location. (3) It has been partially successful in depicting the renal pelves and the ureters in a limited number of cases. (4) In a number of cases it assists in revealing the kidney itself through intensifying the renal shadow. (5) It has been proved a success in revealing the existence of residual urine in the bladder and in furnishing approximate information of the amount, thus eliminating the necessity of catheterization and its attendant dangers of infection. (6) Oral administration of the drug will prove satisfactory for routine use in making roentgenograms of the bladder, while for shadows or the ureters and kidneys intravenous injection of large doses of sodium iodid is desirable."

Duodenal Motility. Homer Wheelon, M.S., M.D. J.A.M.A. 80:615, March 3, 1923.

THIS study was prompted by the finding by some experimenters that duodenal contents are normally regurgitated into the stomach at the close of gastric digestion and by the fact that reverse movements of barium are so often seen during radiographic examinations of the gastro-intestinal tract.

Corroborative evidence is required to complete the studies begun before it can be known whether they have any practical clinical or physiologic value.

The author summarizes his studies thus: "(1) Barium in quantities of from 20 to 60 c.c. may be injected directly into the duodenum without causing distress, the stomach and duodenum having previously been emptied of their contents. (2) The first observed movement of the barium following injection into the duodenum is a more or less complete division of the mass at the point of greatest distention. (3) Following the primary partial division, barium is usually passed along both directions of the duodenum, the central portion being delivered to the upper duodenum or cap, the distal portion to the jejunum. (4) Reverse movements of the barium sooner or later result in the complete filling of the cap, at which point barium may rest for a long period of time. (5) Following distention of the cap by reverse movements, barium is passed forward by progressive movements which at times carry material through the point of original duodenal distention to lower segments. (6) Barium may be delivered from the point of distention to the stomach as the result of reverse movements. In the majority of instances, barium is passed into the stomach only after several injections of the duodenum. (8) Barium tends to rest at the point of injection—inferior flexure. This region is the usual

point of injection. In one instance of jejunum injection, marked reverse movements resulted in the lodgment of barium in the cap, stomach, and inferior flexure."

Relation of the Heart, Pericardium and the Heart Valves to the Anterior Chest Wall. Leon T. LeWald, M.D. Arch. Surg. 6:89, January, 1923.

THE author in his discussion of the value of roentgenograms in diagnosis says the following: "In hypertrophy of the heart, the teleoroentgenogram is the best method of determining the amount of enlargement. When of extreme degree the findings are easily determined. When the question of minor degrees of hypertrophy or gradual increase of the size of the heart is the question to be determined extreme care in technique is necessary in order that the effect of respiration, displacement of the diaphragm, etc., may be taken into consideration. * * * In pericardial effusion, the roentgenologic examination is of great importance but the findings must be interpreted with great care. A case of calcified pericardium gave no physical signs indicative of the condition which was discovered in the fluoroscopic examination. Prior to any surgical procedure involving the chest a careful roentgenologic examination in various positions should always be made."

A Case of Primary Sarcoma of the Heart. L. G. Pinault, M. D., F. A. C. S., Canadian M. A. J. 13:108, February, 1923.

THIS is a case report of a primary round cell sarcoma of the heart in a woman 47 years of age. Postmortem revealed a tumor the size of a hen's egg which completely filled the right auricle.

Tumor of the heart may not produce any morbid symptoms unless it presses upon the auriculoventricular bundle of His, or unless it is so situated as to produce stenosis or regurgitation at a valvular orifice.

In the case reported there was edema of the legs, arms and trunk, greater in the right side than in the left. There was much free fluid in the peritoneal cavity and effusion in the right chest. The pulse was regular but weak; the heart sounds were regular but faint; respiration short and embarrassed; left lung apparently normal; right, dull to percussion with no breathing sounds. The mediastinal and heart shadows were larger than normal.

The author of this paper quotes the following from an article by Dr. I. Perlstein written in 1918: "Only 30 cases of sarcoma of the heart were found after complete search of the literature. To these is added a case in which the tumor originated apparently in the sub-epicardial areolar tissue. There is no characteristic clinical picture of the condition. The symptoms are mostly those of a seriously disturbed cardiac activity. Excessive and repeated hemothorax was the most striking clinical feature of the case reported. Sarcomas of the heart occur at all ages but are most common in the vigorous years of life. Histologically, all types of sarcoma have been reported. The spindle cell variety is the one most frequently found. They occur more often in the auricles than in the ventricles and more frequently in the right than in the left side. Among the postmortem findings pericardial and pleural effusions and edema are common."

X-ray Examinations in Cases of Brain Tumor. Daniel D. Talley, Jr., M.D. Virginia M. Monthly, 49: 639, February, 1923.

X-RAY findings may occasionally establish the diagnosis in a case of brain tumor but this is rare.

Bone tissue growths arising from the wall of the cranial bones and extending inward, pressure changes in the cranial bones, and very occasionally a partly calcified tumor may give definite roentgenographic evidence of tumor but diagnosis established by visualization of the shadow of a soft tissue growth without other roentgen evidence, though it has been done in a few instances, is not possible in most cases. Correct interpretation of the changed appearances accompanying tumor growth is the key to diagnosis.

Air injected into the ventricles followed by x-ray examination has sometimes been of value but is very dangerous and has in some instances been followed by death even when most expertly done. None but a skilled brain surgeon can do it and even then the risk is very great.

Conclusions: "The value of the x-ray as a factor in brain tumor diagnosis depends upon one or more of the following findings registered on the radiographs: (1) Actual visualization of the shadow of the growth itself or of a portion of the same. (2) Alteration in the appearance of the cranial walls or floor due to pressure. (3) Abnormality in the structure of a portion of the skull by reason of the fact that the tumor involves the bone or is attached thereto. (4) Evidence in the cranial walls of a growth which has involved the brain by metastasis. (5) Alteration in the appearance of one or more of the cavities of the brain, after the injection of air for the purpose of visualizing these cavities."

Personal Advances in Deep X-ray Therapy, A New Operating Table for Deep X-ray Therapy. Sinclair Tousey, M.D., Am. J. Electroth. & Radiol. 40:383, December, 1922.

THE writer records great benefit from x-ray treatment of cases of deafness due to atrophy of the optic nerve and plans a future paper upon the subject, in collaboration with Dr. Bell of the New York Eye and Ear Infirmary.

He says: "Tumors of the pituitary gland or of the brain or of the structures at the base of the brain call for the same methods, but with larger doses. Dr. Bell * * * and the present author will shortly report a case of tumor at the base of the brain which had caused blindness in one eye and great loss of vision in the other. Vision was restored in the second eye after deep x-ray therapy by the cross-fire method."

X-ray Treatment in the Diseases of the Ear, Nose and Throat. William A. Evans, M.D., J. Michigan M. Soc. 188:65, February, 1923.

THE writer says he states with confidence that radiation should play a prominent part in treatment of certain diseases of the eye, ear, nose and throat.

The results are not due to direct bactericidal action of the rays but to some bliochemical change wrought by the rays in the tissues.

There is not any danger to the neck glands if proper dosage is used.

The author's conclusions are as follows: "(1) Radiation through the upper respiratory passages has a definite action on the bacterial flora, as evidenced by sterilizaton of the throat, both as regards the Kloebs-Loeffler bacillus and the hemolytic-streptococcus and other organisms. (2) Cases of simple lymphoid hypertrophy both in the child and in the adult, should be treated by radiation rather than by the surgical removal of the offending tissue. (3) There is a type of lymphoid infection in which satisfactory results will be obtained only by the combination of the ultraviolet ray and the x-ray.* (4) Actively infected tonsils should be surgically removed. This includes cases showing the usual serious complications of tonsillitis, such as endocarditis, nephritis, acute arthritis, etc. (5) Little or no beneficial results are obtained in treating tonsils of the fibroid type. (6) Postoperative radiation will increase the percentage of surgical cures. (7) The stmulating action of the ray can be used to overcome low grade infections of the middle ear and also stimulate healing in the several areas.

*Reference is here made in the main part of the text to Pacini upon the combined use of x-rays and ultraviolet rays (See Jour. Radiol. April, 1922).

Indications for Radium Therapy in Ophtho-Otolaryngology. R. E. Loucks, M.D., J. Michigan M. Soc. 22:63, February, 1923.

DR. LOUCKS says that radium treatment is indicated and is specific in basal cell carcinoma which involves the skin covering the orbit and lids of the eye, in epithelioma of the palpebral borders, in lupus vulgaris or rosacea of the skin surrounding the palpebral fissure, in sarcomas, carcinoma and other tumors involving the orbit, in vernal catarrh, pterygium and slow healing ulcers of the cornea or conjunctiva. Relief is offered in trachoma and "questionable benefit" in glaucoma. Palliation is afforded in senile cataract. The cornea and the optic nerve are resistant to the action of the gamma rays of radium.

In treating the external ear or auditory canal caution must be exercised as the cartilage is extremely susceptible to the rays. In radium therapy of the middle ear there is a possibility of bone necrosis if improper technique is used. The author has found that chronic progressive deafness "is benefited in so far as the fibrosis of the external canal intensifies sound." He recommends radium treatment for chronic fistula following operation for mastoids.

The well known pathology of the oral cavity amenable to radium treatment he merely mentions but draws attention to the specific action of the beta rays on leukoplakia of the buccal mucous membrane. He recommends radium treatment for growths within the nares of either septum or turbinals, growths of the pharynx, nasopharynx and tonsils, and says that treatment with radium will prevent recurrence of polpi after surgical removal. Results of treating chronically infected tonsils without excessive hypertrophy are satisfactory in his practice but he has not had success with malignant growths of the larynx.

In treating papillomas direct application is used unless surgical treatment is employed, in the latter case preoperative and postoperative radium treatment is given.

Cervical adenitis, whether tuberculous or staphylococcic, responds to gamma rays of radium. He would radiate all cases of enlarged lymph nodes before tonsillectomy.

Cancer of the Larynx. Chevalier Jackson, M.D., Ann. Surg. 77:1, January, 1923.

THE term "precancerous condition" is used in this paper not in a purely scientific, histological sense, but in the sense of a condition which, while not malignant, is often precursory to malignancy.

Laryngeal irritation from any cause, chronic laryngitis, keratosis, syphilis, pachydermia, so-called prolapse of the ventricle, and benign growths when they occur in a person of precancerous age "may be contributory factors in the etiology of cancer and as such should be cured surgically or otherwise as may be indicated. * * * There will be fewer deaths from laryngeal cancer when every member of the medical profession fully realizes the frequently malign nature of chronic hoarseness."

A Skin Cancer Following Exposure to Radium. Ward J. MacNeal, M.D. *and* George S. Willis, M. D., J. A. M. A. 80:466, February 17, 1923.

THIS reports the case of a patient who was a physician in one of the leading hospitals and who worked with x-rays from 1905 to 1917, employing precautions for self-protection all that time. However, from 1912 to June, 1920, he had handled radium without any such precautions. Up until 1915 he used small quantities but from that time on he used large amounts and had habitually handled individual tubes of from 200 to 365 mg. between the right thumb and forefinger.

Various changes began to be observed late in 1918 and since early in 1920 the skin changes have required constant care. "In September, 1922, a fissure on the ball of the right thumb manifested a peculiar and extremely painful alteration in character, and on excision in October this lesion proved to be a squamous-cell carcinoma."

The authors attribute the growth to the exposure to radium.

Treatment of Leukemia by Means of the X-ray. Jackson W. Landham, M.D., J. M. A. Georgia 12:51, February, 1923.

THE term leukemia is here limited to the myelogenous and lymphatic forms of the disease.

Myelogenous leukemia is clinically made manifest by weakness, splenic tumor, secondary anemia, dyspnea, loss of weight, pain in the left hypochrondriac region in some cases, and a great increase in the total leukocyte count though the differential count may remain practically normal.

Lymphatic leukemia will show enlargement of the lymphatic glands, particularly the cervical and axillary ones, fever, weakness, hemorrhage from the mucous membrane of the nose, mouth or gastro-intestinal tract, also anemia and dyspnea. There is a great increase in the total leukocyte count and the differential count will show this to be due to an increased number of large and small lymphocytes.

All forms of treatment are unsatisfactory in this disease. Pearce, Krumbhaar and Frazier are authorities who say that splenectomy is contraindicated in the various forms of leukemia. Medical treatment with arsenic and benzol may bring temporary symptomatic and hemologic recovery for about a year.

The technique of x-ray treatment is described and five case reports are appended. Of these five cases one has retained a normal blood count since June, 1920, and pursues his usual occupation but requires treatment at intervals of from two to four months. Another patient has retained a normal blood count since May, 1921. Another was kept normal for a period of two years but upon the advice of friends went to another city for radium treatment, and died three months later. The other patients died, one two weeks after treatment was begun and one two months after.

The author's conclusions are: "(1) Blood counts are absolutely necessary in the diagnosis and for the indications of therapy in leukemia. (2) Surgical procedures in leukemia are contraindicated. (3) Medical treatment is of temporary benefit. (4) Radiation therapy produces beneficial resultss by a direct action on the blood cells and by forming leukolytic substances in the blood stream which have the power of lowering the white cell count. (5) Since the percentage of myelocytes does not seem to be reduced unless treatment is applied over the shafts of the long bones it would seem that the dualistic theory of the origin of leukocytes is correct."

The Role of Neoplasia in Parasitic Disease of Plants. Isaac Levin, M.D. *and* Michael Levine, M.D., Cancer Division of the Montfiore Hospital for Chronic Diseases. J. Cancer Research, 7:171, April, 1921.

THE authors' conclusions are as follows: "Neoplasia in parasitic diseases of plants, unlike the neoplasia in animal cancer always represents a protective reaction of the plant organism against the invasion of a parasite.

"Unlike malignant neoplasia in the animal, which has no finality and dies only with the death of the whole host organism, plant neoplasia always completes a life cycle. It has a period of progressive proliferation of undifferentiated cells, is frequently transformed into adult differentiated tissue, and then regression and death occur before the complete destruction of the host. Thus

it behaves more like reactive neoplasia in an animal than like animal cancer.

"Neoplasia in parasitic diseases of plants never represents a malignant tumor in the true meaning of the term in animal pathology.

"Neoplastic tissue in plants is constructed of only one type of cells and presents therefore an ideal material for the study of tumor formation.

"The true relation between the formation of reactive neoplasia and the pathogenesis of malignant tumors in the animal is as yet not established. The relation between infectious granuloma, Hodgkin's lymphoma, and lymphosarcoma—a true malignant tumor—presents an instance. The clearing up of this point may aid greatly in the establishment of the true etiology of cancer.

"The points considered in the previous paragraphs make it evident that the study of neoplasia in plants should become an integral part of all phases of cancer research, whether aiming at the elucidation of the etiology or pathogenesis of the disease or of the correct basis for therapy."

Radium Treatment in Cancer of the Cervix. Clark D. Brooks, M.D., *and* Wm. R. Clinton, M.D., J. Michigan M. Soc. 188:80, February, 1923.

THE factors which determine operability are grouped in outline form. Preoperative x-ray treatment of pelvic lumbar glands, and hypochrondriac regions (both anterior and posterior exposures), and radium locally are used by this author. Two or three weeks later if laparotomy shows no metastases to the liver, lumbar and iliac glands a panhysterectomy is done. This is followed a month later by deep x-ray therapy and another treatment follows in three months.

In borderline cases sometimes radium or x-ray is used alone or combined in preoperative treatment and panhysterectomy follows in four or five weeks.

From 1200 to 3600 mgm. hours of exposure to radium are given.

X-ray Treatment of Uterine Hemorrhage and Fibroid Tumors. John S. Derr, M. D., J. M. A. Georgia 12:56, February, 1923.

A SHORT abstract is given of the fifteen articles reviewed. The first was published in 1904, the last in 1921. The authors are Foveau De Courmelle, Urquhart Bartholomew, Guilleminot and Lacquerriere, Bordier, Harnisch, Raymat of Barcelona, J. A. Corscaden, Kreutzmann, Beclere, L. Martindale, Pfahler, J. E. Panneton, I. W. Edem and L. Provis, A. A. Matthews, and George Shumaker.

The author of the review presents a brief report of forty of his own cases and describes the technique generally used.

Quartz Light Therapy and Its Relation to Preventive Medicine. Leo C. Donnelly, M.D., Am. J. Electroth. & Radiol. 40:390, December, 1922.

THE conditions which have yielded to ultraviolet therapy are listed as follows: baldness, acute ear infection, delayed convalescence after operation for mastoids, diphtheritic throats, septic sore throat (either aborted or duration of attack shortened), pyorrhea alveolaris, Vincent's angina, intestinal infections of diarrheic nature (quickly relieved) and pain of gastric ulcer. In his discussion of the relief afforded in pain from gastric ulcer the author cites a case of long duration, treated by a gastro-enterologist of international reputation. As a last resort before operating the latter referred the patient for ultraviolet treatment and was greatly surprised and gratified with the results as the patient's general health improved wonderfully after six months of combined medical and ultraviolet ray treatment.

The treatment has an anacid effect, a local sedative action upon nerve centers with a general tonic or systemic effect.

No claim is made for cure by quartz light but plus adequate medical care it is of great benefit.